COPY 4/2/01 cw

DOE/OR/07-1939&D1
Secondary Document

Identification and Screening of Candidate Sites for a Potential Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Waste Disposal Facility at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

This document has received the appropriate reviews for release to the public.

Identification and Screening of Candidate Sites for a Potential Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Waste Disposal Facility at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—March 2001

Prepared for the
U.S. Department of Energy
Office of Environmental Management

BECHTEL JACOBS COMPANY LLC
managing the
Environmental Management Activities at the
East Tennessee Technology Park
Oak Ridge Y-12 Plant Oak Ridge National Laboratory
Paducah Gaseous Diffusion Plant Portsmouth Gaseous Diffusion Plant
under contract DE-AC05-98OR22700
for the
U.S. DEPARTMENT OF ENERGY

01-016P(doc)/031901

CONTENTS

FIGURES

TABLES

ACRONYMS

amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
BJC	Bechtel Jacobs Company LLC
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
COE	U.S. Army Corps of Engineers
D&D	decontamination and decommissioning
DOC	U.S. Department of Commerce
DOE	U.S. Department of Energy
EMWMF	Environmental Management Waste Management Facility
EPA	U.S. Environmental Protection Agency
ERWM	Environmental Restoration and Waste Management
FFA	Federal Facility Agreement
FML	flexible membrane liner
HU	hydrologic unit
ICBO	International Conference of Building Officials
KAR	Kentucky Administrative Regulations
KCWD	Kentucky Cabinet for Workforce Development
KDEP	Kentucky Department of Environmental Protection
KDFW	Kentucky Department of Fish and Wildlife
KDFWR	Kentucky Department of Fish and Wildlife Resources
KEQC	Kentucky Environmental Quality Commission
KOW	Kentucky Ordnance Works
KPDES	Kentucky Pollutant Discharge Elimination System
KYTC	Kentucky Transportation Cabinet
LCB	Life Cycle Basis
LDR	land disposal restriction
LLW	low-level waste
LMES	Lockheed Martin Energy Systems, Inc.
MMES	Martin Marietta Energy Systems, Inc.
NCDC	National Climatic Data Center
NEPA	National Environmental Policy Act
NMSZ	New Madrid Seismic Zone
NPL	National Priorities List
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
PCB	polychlorinated biphenyl
PGDP	Paducah Gaseous Diffusion Plant
PSR	preliminary site review
RCRA	Resource Conservation and Recovery Act of 1976
RGA	Regional Gravel Aquifer
RI	remedial investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SWMU	solid waste management unit
T&E	threatened and endangered
TNT	trinitrotoluene

TSCA	Toxic Substances Control Act of 1976
TVA	Tennessee Valley Authority
UCRS	Upper Continental Recharge System
USDA	U.S. Department of Agriculture
USEC	United States Enrichment Corporation
USGS	U.S. Geological Survey
WAC	waste acceptance criteria
WAG	Waste Area Grouping
WES	Waterway Experimental Station
WKWMA	West Kentucky Wildlife Management Area

EXECUTIVE SUMMARY

BACKGROUND

Paducah Gaseous Diffusion Plant (PGDP) was placed on the National Priorities List (NPL) in May 1994. As a consequence of being placed on the NPL, the U.S. Department of Energy (DOE) was required to commence cleanup of PGDP, in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) Section 9620(e)(1), and enter into an interagency agreement governing the cleanup of the facility pursuant to CERCLA Section 9620(e)(2). DOE, the U.S. Environmental Protection Agency (EPA), and the Commonwealth of Kentucky entered into the Federal Facility Agreement for PGDP in 1998.

The DOE is currently evaluating waste disposal alternatives at PGDP to handle wastes generated under CERCLA actions. One of the options for the management of these wastes is construction and operation of an on-site CERCLA waste disposal facility. The purpose of this report is to evaluate the existing DOE-owned property to determine if there are areas suitable for the construction of such a facility.

APPROACH

The on-site CERCLA waste disposal facility is one of several waste management strategies that DOE will evaluate in a Remedial Investigation/Feasibility Study (RI/FS) for disposal of PGDP CERCLA waste. The RI/FS is scheduled for submittal to the regulators in 2002. The results of this siting study will be used in the RI/FS to evaluate alternatives involving on-site disposal.

The overall siting process consists of the following steps. Only Phase I, Stage 1, is completed in this site identification and screening study. Field characterization of one or more of the three final candidate sites will be performed as part of the RI/FS. Results of the field characterization will be documented in the RI/FS report. Final site selection would be described in the Proposed Plan and Record of Decision (ROD).

Phase I, Stage 1: Identify, Screen, and Select Candidate Sites

Stage 1 of the siting process consisted of identifying, screening, and selecting candidate sites on the DOE-owned property. Stage 1 identified an initial list of ten sites, developed criteria to evaluate the sites, and, through screening, identified three final candidate sites for further evaluation in the RI/FS. Stage 1 included the following steps.

- **Develop initial facility concept.** An initial concept for a potential CERCLA waste disposal facility was developed to aid in determination of site suitability. The initial facility concept was based on a preliminary estimate of the volume and nature of waste to be disposed, preliminary estimate of minimum area requirements (facility footprint), and an initial concept of the design (multiple cells with support facilities), as defined in the *Initial Assessment of Consideration of On-Site Disposal of CERCLA Waste as a Potential Disposal Option at the PGDP* (DOE 2000a).

- **Identify candidate sites.** Using the initial facility concept, an initial list of ten candidate sites was established. Because the DOE Paducah Site is relatively small, there are a limited number of sites where this type of facility can be placed.

- **Establish site screening criteria.** Siting criteria were developed to allow early screening of sites. Specific siting criteria were established by evaluation of applicable or relevant and appropriate requirements (ARARs) and by review of existing literature on local geology, hydrology, seismic conditions, land use plans, and other topographic features.

- **Conduct screening.** The screening process consisted of preliminary and final screening steps. Preliminary screening reduced the number of candidate sites to six, and final screening reduced the number of candidate sites to three. These final candidate sites are then referred to the RI/FS.

The methodology and results of the Phase I, Stage 1 screening evaluations are presented in this report. The report also describes the three final candidate sites. The results will be incorporated into the *RI/FS on Disposal Options for CERCLA-Derived Waste at the PGDP, Paducah, Kentucky* (DOE 2001, to be published) and used to evaluate alternatives involving on-site disposal.

Phase I, Stage 2: Final Site Selection

A field characterization study (seismic, geotechnical, hydrogeologic, etc.) will be performed at one or more of the three final candidate sites as part of the RI/FS to determine the recommended final site for a potential on-site CERCLA waste disposal facility. The results of the field characterization will be documented in the RI/FS report. Final site selection would be described in the Proposed Plan and ROD.

Phase II, Design of a Disposal Facility

Phase II of the site selection process would consist of site characterization that would support design of a potential on-site CERCLA waste disposal facility. The scope of these tasks would include pre-design studies, preparation of remedial design work plans, and other tasks associated with facility design, as appropriate. Phase II would proceed only if it appears likely that an on-site waste disposal facility would be part of the selected remedy. These tasks may be implemented prior to final ROD signatures, in agreement with the regulators.

DESCRIPTION OF PROPOSED FACILITY

Types of Waste Accepted

The types of CERCLA waste designated for disposal in a potential on-site facility would include near-term wastes to be generated from environmental restoration activities and wastes generated from the decontamination and decommissioning (D&D) of facilities located at PGDP. The waste generated would include low-level waste (LLW); waste defined under the Resource Conservation and Recovery Act of 1976 (RCRA); waste defined under the Toxic Substances Control Act of 1976 (TSCA); and mixed wastes consisting of combinations of these waste types. The D&D activities are eligible to be conducted under CERCLA, consistent with the *Policy on Decommissioning of Department of Energy Facilities under CERCLA* (DOE 1995). Any waste accepted in an on-site CERCLA waste disposal facility would be required to meet the facility's waste acceptance criteria (WAC), which would be established in agreement with the regulators.

Design Volume

The conceptual design of a CERCLA waste disposal facility is based on the facility receiving the following volume of waste (DOE 2000a). The waste volume inventory will be updated in the RI/FS.

- Near-term environmental restoration and D&D wastes 600,000 yd^3
- Future D&D waste 2,500,000 yd^3
- Total waste volume 3,100,000 yd^3

Minimum Area Requirements

The potential on-site CERCLA waste disposal facility would consist of a 3.1M-yd^3 capacity above-grade, earthen cell with a composite cap. The facility would be designed to meet ARARs for the disposal of LLW, RCRA, and TSCA wastes. Support facilities include those for staging, temporary storage, decontamination, and operation and maintenance of the facility. Additional area is required for stormwater management, security, and weighing facilities.

Based on projected waste volumes and cell design assumptions, the disposal cell is estimated to require 30 acres for waste placement. The surrounding earthen dike would encompass an additional 50 acres. Support facilities would require another 30 acres. The total CERCLA waste disposal facility footprint would require approximately 110 acres, including roads and support facilities.

The facility conceptual design includes the following:

- clean-fill dike around the perimeter of the cell;
- geologic buffer as required to meet ARARs;
- 6-ft thick multilayer liner system with primary and secondary leachate collection/detection systems; and
- 16-ft thick permanent cover with primary and secondary hydraulic barriers, drainage layer, and bio-intrusion layer.

IDENTIFICATION OF CANDIDATE SITES

A preliminary review was conducted to identify candidate sites for the potential waste disposal facility. The preliminary review involved reviewing a base map of the DOE-owned property and discussing areas known or suspected to be unsuitable with personnel knowledgeable of conditions at PGDP. Areas that (1) potentially compromised long-term objectives, (2) were considered technically impractical, or (3) were too cost prohibitive to mitigate using engineering controls were not considered. Ten candidate waste disposal facility sites were identified, as shown in Fig. ES.1.

SITE SCREENING CRITERIA

Site screening criteria were arranged in multiple levels to allow early elimination of sites. Specific site screening criteria were established by evaluation of ARARs and by review of existing literature on local geology, hydrology, seismic conditions, land use plans, and other topographic features. Site screening criteria were identified in three general categories.

THIS PAGE UNAVAILABLE
FOR
PUBLIC RELEASE

IF YOU WISH TO VIEW,
PLEASE CALL
BECHTEL JACOBS SECURITY
(PHONE: 441-5037)

(1) Threshold Criteria: Regulatory, technical, or land ownership requirements that would prohibit construction of a facility or make construction infeasible. Threshold criteria include minimum site area requirements, locations of floodplains, and seismic considerations for siting a facility. All sites must be located within existing DOE-owned property.

(2) Modifying Criteria: Those criteria that, when considered alone or with other modifying criteria, could affect the ability of a facility to meet its performance requirements or would render development of the facility technically impractical or cost prohibitive. The modifying criteria are more flexible than the threshold criteria in that if a site does not meet the objectives of a modifying criterion, then facility design would focus on mitigating measures. Examples of modifying criteria include hydrologic considerations, presence of wetlands, incompatible land use, demographic considerations, and other factors.

(3) Final Criteria: Programmatic considerations or other criteria deemed by DOE or stakeholders to directly affect selection of a site.

A summary of the site screening criteria is shown in Table ES.1.

PRELIMINARY SCREENING

The site screening process is an iterative process that applied screening criteria in successive steps to subsequently identify sites that will be carried forward into the RI/FS. Preliminary screening evaluated the ten candidate waste disposal facility sites against the designated threshold criteria, which included the following:

- available area,
- floodplains, and
- seismic considerations.

These screening criteria were established based on acreage requirements, design assumptions, and performance objectives and by extracting relevant disposal siting information from ARARs.

Available Area

All ten candidate sites meet the minimum area requirement of 110 acres.

Floodplains

Flooding is associated with the Ohio River, Bayou Creek, and Little Bayou Creek. The majority of overland flooding is associated with the Ohio River floodplain. Flooding of Bayou and Little Bayou creeks is generally confined to the areas within and immediately adjacent to the channels of these streams. A floodplain analysis performed by the U.S. Army Corps of Engineers in 1994 found that much of the built-up portions of the plant lie outside the 100- and 500-year floodplains of these streams.

Portions of Sites 1, 2, 4, 7, and 10 are located within the 100-year floodplain. Sites 2, 4, 7, and 10 have large areas located within the 100-year floodplain of Bayou Creek or Little Bayou Creek. Because the area impacted by the floodplain was large enough to impact the waste cell portion of the facility, these sites were eliminated from further consideration. Site 1, however, has only a small area along the northern fringe of the site in the Bayou Creek floodplain, and this was considered minor enough to retain Site 1.

Table ES.1. Site screening criteria for potential PGDP CERCLA waste disposal facility

Site screening criteria	Type of criteria	Requirement	Reference
Available Area	Threshold criteria	• Total waste volume: 3.1 million yd^3 • Area required for waste cell: 30 acres • Area required for waste cell and containment dike: 80 acres • Area required for support facilities: 30 acres • Total facility footprint: 110 acres	Initial Assessment of Consideration of On-Site Disposal of CERCLA Waste DOE/OR/07-1893&D1, July 2000
Available Area	Threshold criteria	• Locate entirely within DOE boundary (no land purchase) • No relocation of Ogden Landing Road • Minimize impacts to existing facilities	DOE Programmatic requirement
Floodplains	Threshold criteria	• Avoid disposal in 100-year floodplain. If located in 100-year floodplain, must be designed to prevent washout • Cannot construct in floodway • Cannot restrict flow of the 100-year flood or reduce temporary water storage capacity of the 100-year flood so as to pose a hazard to human life, wildlife, or land or water resources	401 KAR 34:020 Section 9 Location Standards 902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal 40 *CFR* 264.18(b)(1) 10 *CFR* 61.50 Disposal Site Suitability Requirements for Land Disposal
Seismic Considerations	Threshold criteria	• Seismic considerations; facility will not be located within approximately 200 ft of a fault that has had displacement in Holocene time • Avoid areas where tectonic processes, such as faulting, folding, seismic activity, or vulcanism, may occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives	40 *CFR* 264.18 401 KAR 38:090 401 KAR 34:020 Section 9 (1) Location Standards 902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal

Table ES.1. Site screening criteria for potential PGDP CERCLA waste disposal facility (continued)

Site screening criteria	Type of criteria	Requirement	Reference
Hydrologic Considerations	Modifying criteria	• Provide sufficient depth to groundwater to prevent intrusion into the waste (TSCA has 50-ft buffer requirement) • Avoid proximity to drinking water wells or high value groundwater • Cannot construct in seasonal high water table • Distance to perennial streams • Minimize upstream drainage area • Shall not discharge groundwater to the surface within the disposal site • Avoid areas of vulnerable hydrogeology	401 KAR 34:020 Section 9 (1) Location Standards 902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal 10 *CFR* 61.50 Disposal Site Suitability Requirements for Land Disposal
Wetlands	Modifying criteria	• Avoid disposal in wetland	902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal 10 *CFR* 61.50 Disposal Site Suitability Requirements for Land Disposal
Karst Soils	Modifying criteria	• Avoid placement within 250 ft of sinkhole (None known to exist at PGDP)	902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal
Unstable Terrain	Modifying criteria	• Avoid surface geologic processes, such as mass wasting, erosion, slumping, landsliding, or weathering, with a frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives • Avoid areas of potential liquefaction	902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal 10 *CFR* 61.50 Disposal Site Suitability Requirements for Land Disposal 40 *CFR* 761.75 (b)(5)
Unfavorable Weather Conditions	Modifying criteria	• Avoid stagnant weather conditions, non-attainment areas, etc. (None known to exist at PGDP)	EPA Siting Guidance
Incompatible Land Use	Modifying criteria	• Avoid areas where nearby facilities or activities could adversely impact the ability of the site to meet the performance objectives • Avoid areas of existing contamination • Industrial land use preferred over recreational land use	902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal DOE 435.1 DOE Programmatic requirement

Table ES.1. Site screening criteria for potential PGDP CERCLA waste disposal facility (continued)

Site screening criteria	Type of criteria	Requirement	Reference
Transportation/ Access	Modifying criteria	• Optimize site access from sources of waste generation to minimize adverse environmental or public impacts during shipment to the waste disposal facility • Minimize replacement or construction of roads or rail lines	NEPA transportation impacts
Buffers	Modifying criteria	• Distance to sensitive environmental areas (including WKWMA) • Distance to site boundaries • TSCA requirement for 50 ft buffer between the bottom of the landfill and the top of the water table • Avoid placement within 250 ft of perennial stream	40 *CFR* 761.75(b)(3)
NEPA Considerations	Modifying criteria	• Threatened & Endangered Species (Indiana bat habitat areas) • historic/archaeological sites (cemetaries) • Avoid areas having known natural resources (e.g., sensitive habitats, ecosystems) which, if exploited, would result in failure to meet the performance objectives (protection of the environment)	902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal 10 *CFR* 61.50 Disposal site suitability requirements for land disposal EPA 2000
Demographic Considerations	Modifying criteria	• Located in area where projected population growth and future developments are not likely to affect the ability of the disposal facility to meet the performance objectives • Avoid impacts to lowincome or minority populations • Distance to nearest church, school, house, well	902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal 10 *CFR* 61.50 Disposal Site Suitability Requirements for Land Disposal EPA 1997 Programmatic requirements
Programmatic Considerations	Final criteria	• Time frame for availability of facility in relation to other CERCLA actions, cost of development	CERCLA, NCP Programmatic requirements

Seismic Considerations

Most of the seismic hazard of the PGDP area is attributed to the New Madrid Seismic Zone (NMSZ). The focus of the NMSZ occurs to the southwest of PGDP within the Reelfoot rift. The International Building Code seismic hazard zone map shows PGDP to be located on or near the margin between a Seismic Hazard Zone of 3 and 2A (ICBO 1988).

Regulatory requirements stipulate that a disposal facility cannot be located within approximately 200 ft of a fault that has had displacement in Holocene time. The requirements also indicate that tectonic processes (e.g., faulting, folding, seismic activity, or vulcanism) should be avoided where they occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives.

Although there are published reports of Pleistocene-age faults and lineaments at PGDP, there is no clear evidence of Holocene Epoch (within the last 10,000 to 12,000 years) faulting at PGDP. Drahovzal and Hendricks (1996), in a Kentucky Geological Survey Open-File Report, documented the presence of several lineaments at PGDP that parallel fault trends evident in southern Illinois. In addition, seismic reflection studies indicate that faulting of the bedrock and at least some of the overlying sediments is pervasive at PGDP (Street and Langston 1998). For the purpose of the siting study, Pleistocene-age faults and lineaments were considered undesirable if they traverse a candidate site, but were not used to exclude a site from further consideration. Given the present uncertainty regarding the existence of lineaments and the age of faults, all potential sites were considered essentially equivalent from a seismic perspective .

Site-specific analyses indicate that PGDP has low potential to be impacted by liquefaction and soil settlement in the event of an earthquake (Sykora and Davis 1993). The location of PGDP on an upland surface above the alluvial valley of the Ohio River is the foremost factor that contributes to the low potential for liquefaction. Therefore, based on information reviewed to date, DOE has concluded that seismic hazard is not a barrier to the construction and long-term performance of a potential on-site CERCLA waste disposal facility at PGDP.

Discussions of seismic issues are continuing with the regulators and detailed studies of seismic issues are being conducted in conjunction with the regulators. The evaluations made in this siting study have been made based on a review of existing literature and existing documents. Final candidate sites will be carried forward for further evaluation in the RI/FS. The evaluations that will be made in the RI/FS will be based on a review of additional existing literature or documents, and . field characterization at one or more of the final candidate sites will be conducted. The results of the field characterization will be reported in the RI/FS. Field characterization may include appropriate reconnaissance surveys of potential liquefaction features, geophysical seismic reflection surveys, deep borings with field testing of shear wave velocities, and site-specific fault studies. This field characterization will be used to d confirm the seismic conditions at the final candidate sites particularly with respect to peak ground acceleration, presence of potential Holocene-age faults, and potential for liquefaction. The results of this field characterization will be documented in the RI/FS.

FINAL SCREENING

Sites 2, 4, 7, and 10 were eliminated based on the preliminary screening; therefore, Sites 1, 3, 5, 6, 8, and 9 were carried forward for final screening. The six candidate sites fall into one of three general site areas with distinctively different characteristics:

- sites located outside the secured area and on the Porters Creek Terrace (Sites 1 and 3);
- site located within the secured area of PGDP and above the RGA, "brownfield" site (Site 9); and
- sites located outside the secured area and above the RGA (Sites 5, 6, and 8).

Six technically feasible candidate sites (i.e., Sites 1, 3, 5, 6, 8, and 9) were evaluated against the modifying and final criteria during the final screening process. The results of the Final Screening are discussed in Table ES.2.

FINDINGS AND RECOMMENDATIONS

After review of the modifying and final criteria, a site was selected from each of the three general site areas. The three sites recommended for further evaluation in the RI/FS are Site 1, Site 5, and Site 9. These three final candidate sites all appear to be technically viable and offer a range of technical and programmatic attributes. A description of each site and the rationale for its selection are discussed below.

Site 1

Site 1 is located in the southwest quadrant of the DOE-owned property in the watershed of Bayou Creek (Fig. ES.1). The site is bounded to the east by the main rail line to PGDP and by a tributary of Bayou Creek on the north. Site 1 was recommended for further evaluation based on the following.

- The site meets the minimum land requirement of 110 acres.
- The site is predominantly located out of the floodplain of Bayou Creek.
- Site 1 meets the seismic criterion of avoiding areas that are within 200 ft of a fault that has displacement in Holocene time (within the last 10,000 to 12,000 years). There are no known Holocene-age faults within 200 ft of the site. This would be confirmed during Phase I, Stage 2 field characterization. There is, however, a postulated lineament that crosses the western edge of the site.
- The most significant feature of Site 1 is that it is located in an area that overlies the Porters Creek Clay formation. The Porters Creek Clay is approximately 100-ft thick in areas immediately southwest of the PGDP site and represents a significant geologic feature for siting a waste disposal facility.
- With the exception of overhead transmission lines that cross the site, there are currently no industrial facilities or solid waste management units located within the boundaries of Site 1 that would delay startup of a waste disposal facility.
- The site is located upgradient of existing groundwater contamination areas, which would facilitate monitoring of releases from the proposed waste management facility.
- The site is easily accessible by rail or road for transport of construction materials or waste. An existing rail line parallels the site.
- Site 1 is located between the old Kentucky Ordnance Works site and the existing PGDP industrial area, well away from residential areas.

Table ES.2. Site comparison for potential CERCLA waste disposal facility

			Terrace		RGA			Brownfield
		Criteria	Site 1	Site 3	Site 5	Site 6	Site 8	Site 9
THRESHOLD CRITERION	**Available Area**	110-acre available area	Yes	Yes	Yes	Yes	Yes	Yes
		Within DOE boundary	Yes	Yes	Yes	Yes	Yes	Yes
		Facility demolition required?	No	Yes	No	No	No	Yes
	Floodplains	Prominently located within 100-year floodplain	No < 1%	No 0%	No < 10%	No 0%	No 0%	No < 1%
	Seismic Considerations	≥ 200 ft of Holocene faults & lineaments	Yes, exceeds criterion	Yes, exceeds criterion	Yes, exceeds criterion	Yes, exceeds criterion	Yes, exceeds criterion	Yes, exceeds criterion
MODIFYING CRITERION	**Hydrologic Considerations**	≥50 ft depth to groundwater	No, <15 ft	No, ≤ 15 ft	No, ≤40 ft	No, ≤40 ft	No, ≤40 ft	No, < 15 ft
		Distance to drinking water wells[1]	See note 1	See note 1	See note 1	See note 1	See note 1	See note 1
		Distance to perennial streams	~100 ft	~1,000 ft	< 100 ft	~2,000 ft	~1,000 ft	~1,000 ft
		Upstream drainage areas	No	No	No	No	No	No
		Groundwater discharge within the proposed waste disposal facility site	Gaining in Bayou Creek	Gaining in Bayou Creek	Losing in Little Bayou Creek	Losing in Little Bayou Creek	Losing in Little Bayou Creek	Losing in Bayou Creek
		Vulnerable hydrogeology	Yes (gravel)	Yes (gravel)	Yes (plume)	Yes (plume)	Yes (plume)	Yes (plume)
		Rate of groundwater movement on the RGA	N/A, site not on RGA	N/A, site not on RGA	Slow movement	Slow movement	Moderate movement	Slowest movement
	Wetlands	Designated wetland area	Yes (~20%)	Yes (~30%)	Yes (~20%)	Yes (~10%)	Yes (~90%)	No (~1%)
	Karst Soils	Distance to karst ≥250 ft	Yes	Yes	Yes	Yes	Yes	Yes
	Unstable Terrain	Surface geologic processes	No	No	No	No	No	No
		Areas of potential liquefaction	No per WES Model	No per WES Model	No per WES Model	No per WES Model	No per WES Model	No per WES Model
	Unfavorable Weather	Stagnant weather conditions	No	No	No	No	No	No
	Incompatible Land Use	Adverse impacts from nearby facilities	No	No	No	No	No	No
		Areas of existing contamination (SWMUs)	No	Yes	Yes	Yes	Yes	Yes
		Industrial vs. recreational land use	No	No	No	No	No	No
	Transportation Access	Site access	Accessible	Accessible	Accessible	Accessible	Accessible	Accessible
		Impacts to roads/railroads	Yes, road	Yes, road & railroad	No	No	Yes, road	No
	Buffers	Distance to sensitive environmental areas	~ 5 Miles	~ 5 Miles	~ 5 Miles	~ 5 Miles	~ 5 Miles	~ 5 Miles
		Distance to DOE boundaries	≤100 ft	≤100 ft	≤700 ft	≤50 ft	≤50 ft	≤1,300 ft
		≥50-ft buffer between landfill and water table	No < 20 ft	No < 20 ft	No ≤50 ft	No ≤50 ft	No ≤50 ft	No ≤20 ft
		≥250 ft to streams	No	Yes	No	Yes	Yes	Yes
	NEPA Considerations	T&E species	None observed, potential bat habitat in southern portion of site	None observed	None observed	None observed	None observed	None observed
		Historical & archaeological sites	No	No	No	No	No	No
		Natural resource area (Tupelo Swamp)	< 3 miles	< 3 miles	< 2 miles	< 2 miles	< 2 miles	< 2 miles
	Demographic Considerations	Effects on projected population growth	None	None	None	None	None	None
		Distance to schools, church, houses, etc.	<1 mile	< 1 mile	< 1 mile	< 1 mile	< 3 miles	< 3 miles
FINAL CRITERION	**Programmatic Considerations**	Availability/time frame of facility vs. other actions	2004	2004 vs. DUF_6 schedule	2004	2004	2004	2004 vs. SWMU remediation schedule
		Length of postulated faults or lineaments	~1,500 ft	~500 ft	~1,800 ft	~1,300 ft	~1,300 ft	~3,500 ft
		Relocation of Ogden Land Road required?	No	No	No	No	No	No
		Other considerations	Requires rerouting of streams and ~6,600 ft of power lines	Proposed DUF_6 Conversion Facility Site, requires rerouting of streams and ~4,000 ft of power lines	Requires rerouting of streams and ~8,000 ft of power lines	Requires rerouting of ~13,200 ft of power lines	Requires rerouting of streams and ~12,000 ft of power lines, raw water line	Requires rerouting of diversion ditch and raw water line

1. Residences within the DOE Water Policy Boundary are provided with municipal water.

- There are no residential wells within 4000 ft of the site.
- Wetland impacts and mitigation requirements for Site 1 would be less than for other sites.
- Land use designation for Site 1 is recreational use-DOE property, per the approved PGDP SMP (DOE 2000b).

Site 5

Site 5 is located in the northeastern quadrant of the DOE-owned property in the watershed of Little Bayou Creek (Fig. ES.1). The site is bounded to the west by the secured area of PGDP and to the east by Little Bayou Creek. Site 5 was recommended for further evaluation based on the following.

- The site meets the minimum land area requirement of 110 acres. Topography at the site is amenable to development with only minor relief across the site (20 ft). There are no areas of unstable terrain in the vicinity of Site 5.
- Site 5 meets the seismic criterion of avoiding areas that are within 200 ft of a fault that has displacement in Holocene time (within the last 10,000 to 12,000 years). There are no known Holocene-age faults within 200 ft of the site. This would be confirmed during Phase I, Stage 2 field characterization.
- Site 5 is located entirely out of any floodplain.
- Although there are some wetland areas on the site, they tend to be small and discontinuous.
- With the exception of overhead transmission lines that cross the site, there are currently no industrial facilities located on Site 5 that would require removal.
- Contaminant transport from Site 5 to the Regional Gravel Aquifer (RGA) is the second slowest of the five sites located above the RGA.
- Land use designation for Site 5 is recreational use-DOE property, per the approved PGDP SMP (DOE 2000b).

Site 9

Site 9 is located in the northwest corner of the secured (fenced) portion of the PGDP site (Fig. ES.1). Site 9 was recommended for further evaluation based on the following.

- Site 9 meets the minimum area requirement of 110 acres.
- Site 9 is located above any floodplain except for a drainage ditch running through the site.
- Site 9 meets the seismic criterion of avoiding areas that are within 200 ft of a fault that has displacement in Holocene time (within the last 10,000 to 12,000 years). There are no known Holocene-age faults within 200 ft of the site. This would be confirmed during Phase I, Stage 2 field characterization. Site 9 is located on land previously developed for industrial purposes and is considered stable.

- Site 9 represents a "brownfield" site within the secured portion of the plant site, which would minimize impacts to more pristine sites.
- There would be no additional encroachment on wetlands, terrestrial habitat, or threatened and endangered species.
- No further expansion of the secured area would be required.
- The potential to spread contamination footprint is reduced.
- Existing infrastructure could be used to support the facility (roads, water, electrical, etc.).
- Site 9 is the only site that does not contain wetlands.
- The velocity of contaminant transport from Site 9 is the lowest of the five sites that are located above the RGA.
- Relative to the other sites, Site 9 is the least impacted from overhead transmission lines.
- Land use designation for Site 9 is industrial land use per the approved PGDP SMP (DOE 2000b).

Final Site Selection

Sites 1, 5, and 9 should be further evaluated in the *RI/FS on Disposal Options for CERCLA-Derived Waste at the PGDP* (DOE2002, to be published). Field characterization will be implemented as part of the RI/FS. A key aspect of the field characterization will be to address potential Holocene faulting or liquefaction. Results of the field characterization will be documented in the RI/FS report. Final site selection would be documented in the Proposed Plan and ROD.

If it appears likely that an on-site CERCLA waste disposal facility would be part of the selected remedy, additional site characterization activities (e.g., geotechnical foundation investigations, borrow material areas, etc.) would be conducted to support design of the waste disposal facility. These site characterization activities could be initiated prior to final ROD signatures, in agreement with the regulators.

1. INTRODUCTION

1.1 BACKGROUND

Paducah Gaseous Diffusion Plant (PGDP) was placed on the National Priorities List (NPL) in May 1994. As a consequence of being placed on the NPL, the U.S. Department of Energy (DOE) was required to commence cleanup of PGDP, in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Section 9620(e)(1) and enter into an interagency agreement governing the cleanup of the facility pursuant to CERCLA Section 9620(e)(2). DOE, the U.S. Environmental Protection Agency (EPA), and the Commonwealth of Kentucky entered into the Federal Facility Agreement (FFA) for PGDP in 1998.

It is anticipated that approximately 600,000 yd^3 of near-term CERCLA and decontamination and decommissioning (D&D) waste will be generated as a result of the response and remedial actions currently planned under the PGDP FFA. Future activities may result in an additional 2,500,000 yd^3 of waste. The D&D activities are eligible to be conducted under CERCLA, consistent with the *Policy on Decommissioning of Department of Energy Facilities under CERCLA* (DOE 1995). These waste volumes are based on an initial assessment of CERCLA waste disposal options at PGDP (DOE 2000). The waste volume inventory will be updated in a Remedial Investigation/Feasibility Study (RI/FS), which is being written concurrent with this document.

For the purpose of this siting study report, PGDP refers to the industrial plant facility located inside the fenced security area. The Paducah Site includes all DOE-owned property on or surrounding PGDP.

The DOE is currently evaluating waste disposal alternatives at PGDP to handle these wastes in a responsible and cost-effective manner. One of the options for the management of the waste to be generated under these CERCLA actions is construction and operation of an on-site waste disposal facility. The purpose of this report is to evaluate the existing DOE-owned property to determine if areas on DOE property are suitable for construction of such a facility.

1.2 APPROACH

An on-site waste disposal facility is one of several waste management strategies that DOE will evaluate in a Remedial Investigation/Feasibility Study (RI/FS) for disposal of PGDP CERCLA waste (DOE 2001, to be published). The RI/FS is scheduled for submittal to regulators in 2002. The results of this siting study will be used in the RI/FS to evaluate alternatives involving on-site disposal. This report presents the methodology used to identify, screen, and select candidate sites that would subsequently be used in developing any on-site disposal alternatives in the RI/FS.

The overall site selection process consists of candidate site identification, site screening, preliminary field characterization of final candidate sites, and selection of a preferred site. Site identification and screening for a potential on-site CERCLA waste disposal facility at PGDP have been conducted in a manner similar to the process used for site selection for the Environmental Management Waste Management Facility (EMWMF) for the Oak Ridge Reservation (DOE 1996a). The final candidate sites resulting from this screening will be further evaluated in the RI/FS. Field characterization of the final candidate sites will be implemented as part of the RI/FS and the results will be documented in the RI/FS Report. Final site selection would be described in the Proposed Plan and ROD.

If it appears likely that an on-site CERCLA waste disposal facility would be part of the selected waste disposal remedy, then a site would be characterized in sufficient detail to support facility design and construction. Phase II site characterization could be initiated prior to final Record of Decision (ROD) signatures.

The overall siting process consists of the following steps:

- Phase I: Site Selection Approach

  - Stage 1: Identify, Screen, and Select Candidate Sites
    (a) Develop initial facility concept
    (b) Identify candidate sites
    (c) Establish site screening criteria
    (d) Conduct screening process
    (e) Prepare siting study report

  - Stage 2: Final Site Selection
    (a) Conduct field characterization
    (b) Incorporate Stage 1 results into the RI/FS
    (c) Incorporate field characterization results into the RI/FS
    (d) Select final site
    (e) Describe final site in the Proposed Plan and ROD

- Phase II: Design of a Disposal Facility

The site selection process is illustrated in Figs. 1.1 and 1.2. A brief description of the steps in the siting process and their location in the report is included below.

1.2.1 Phase I, Stage 1: Identify, Screen, and Select Candidate Sites

Stage 1 of the site selection approach consists of identifying, screening, and selecting candidate sites on the DOE-owned property. Stage 1 identifies an initial list of ten sites, develops criteria to evaluate the sites, and, through screening, identifies the three most suitable sites for further evaluation in the RI/FS. Stage 1 includes the following steps.

Develop initial facility concept

An initial concept for a potential CERCLA waste disposal facility was developed to aid in determination of site suitability. The initial facility concept was based on

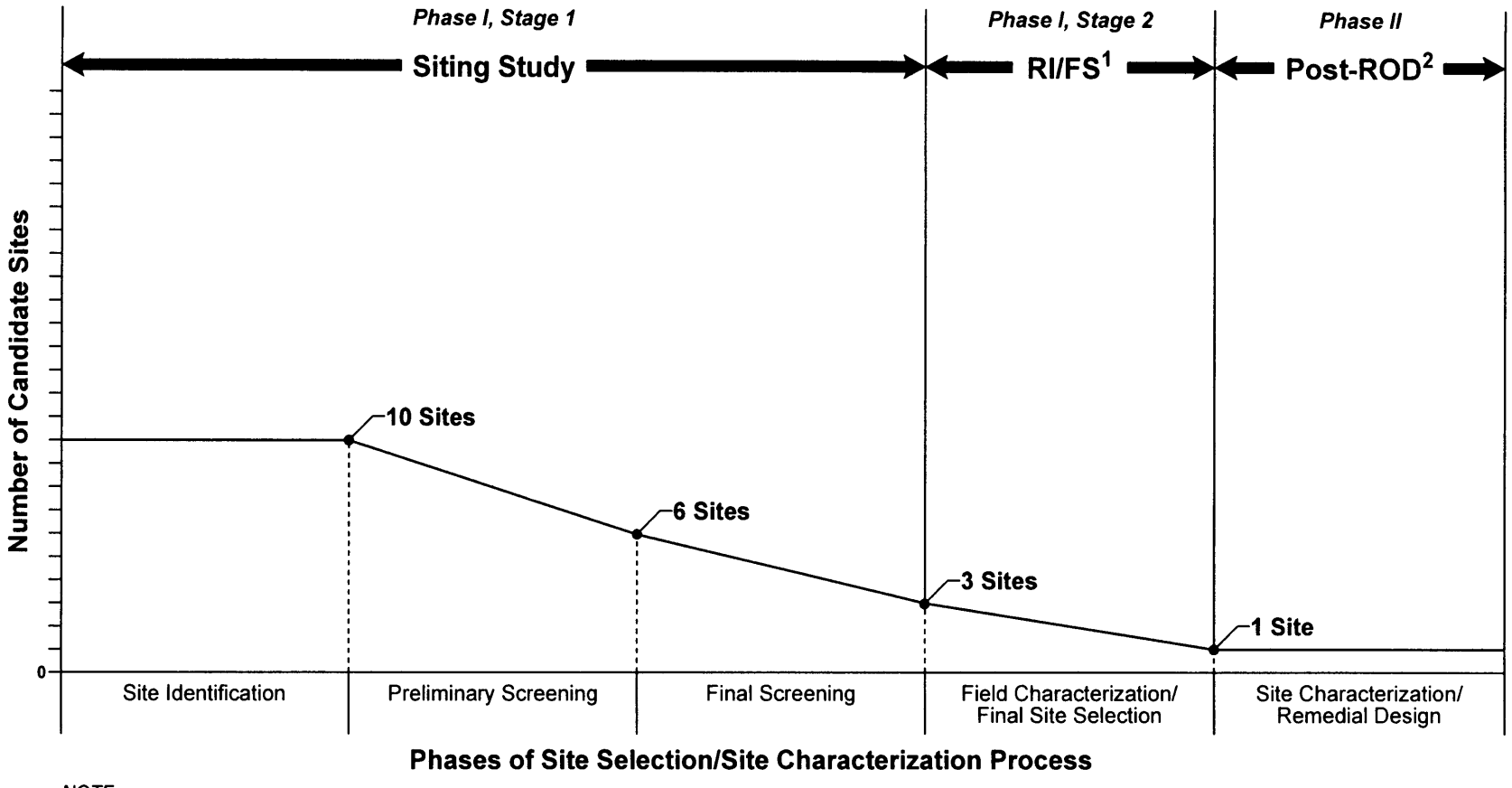
- preliminary estimate of the volume and nature of waste to be disposed;
- preliminary estimate of minimum area requirements (facility footprint); and
- initial concept of design (single cell vs. multiple cells, support facilities, etc.).

The initial facility concept is presented in Chap. 2 of this report.

Identify candidate sites

Using the initial facility concept, an initial list of candidate sites was established. The list of candidate sites was established through the following process:

- document reviews and interviews with knowledgeable facility personnel,
- review of previous facility siting efforts,



NOTE:

[1] Phase I Stage 2 field characterization will be conducted as part of the RI/FS and the results will be documented in the RI/FS report. Final site selection would be described in the Proposed Plan and ROD.

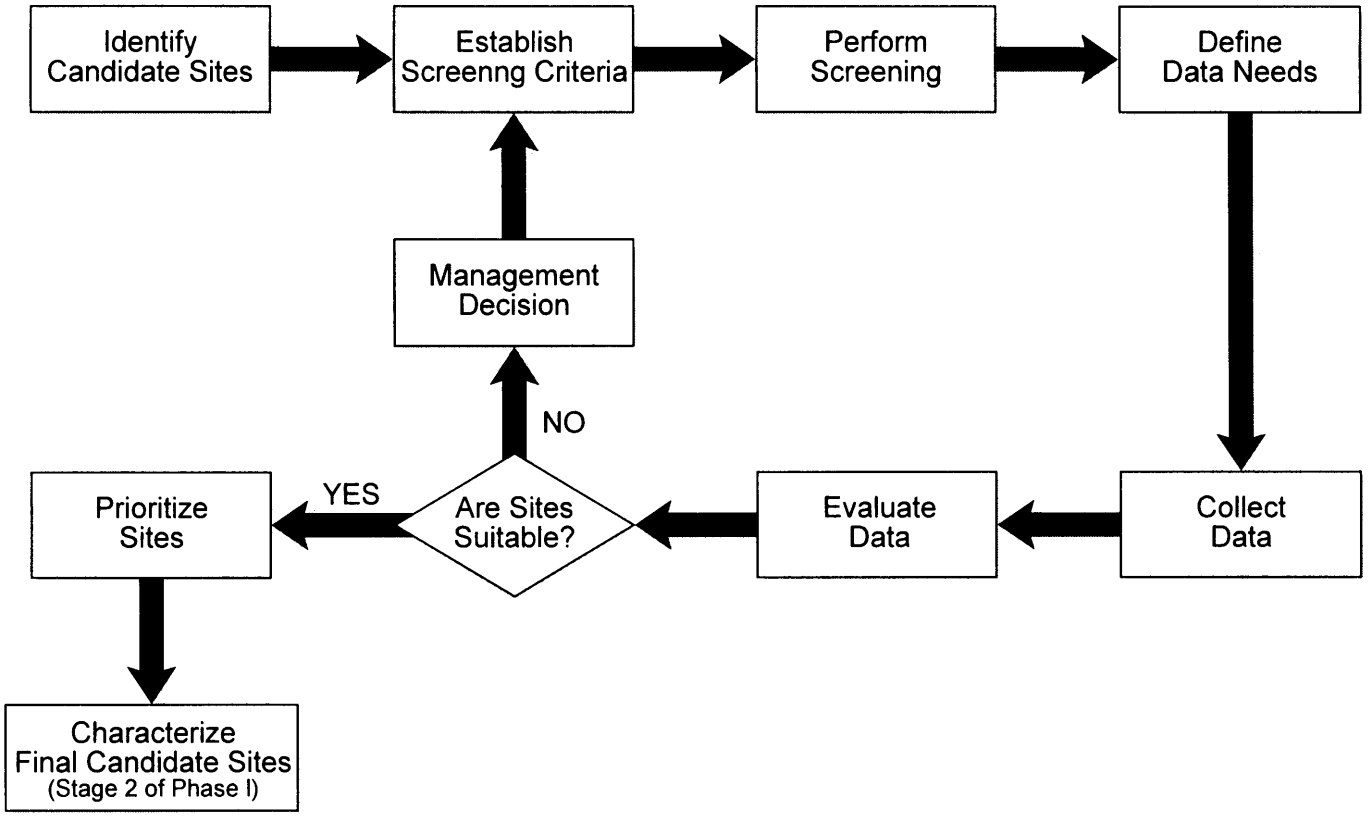
[2] Phase II site characterization for remedial design would be conducted if it appears likely that an on-site CERCLA waste disposal facility would part of the selected remedy and may be initiated prior to final ROD signatures.

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR227000
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 1.1 Site selection/site characterization process



Source: DOE / OR / 02 - 1508 & D1 1996

Fig. 1.2 Phase I site selection approach.

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS Bechtel Jacobs Company LLC

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-98OR227000
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

SAIC

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

- meeting threshold criteria, and
- land use planning studies.

A description of the candidate sites is included in Chap. 4.

Establish site screening criteria

Site screening criteria were developed in multiple levels to allow early elimination of sites determined not to be technically feasible. Specific siting criteria were established by evaluation of applicable or relevant and appropriate requirements (ARARs) and review of existing literature on local geology, hydrology, seismic conditions, land use plans, and other topographic features. Siting criteria used in the evaluation include the following:

- Threshold criteria
  - Available area (based on minimum area requirements),
  - Geologic features (particularly seismic considerations such as distance to faults and lineaments),
  - Topographic or constructability limitations,
  - Hydrologic features such as floodplains,
  - Land use considerations (current land use, future use of proposed site, future use of adjacent properties);
- Modifying criteria
  - Location/access and transportation requirements,
  - Buffers, including regulatory/ARAR-based buffers, vertical separation of wastes from uppermost aquifer, distance to sensitive environmental areas, site boundaries,
  - National Environmental Policy Act (NEPA) considerations [threatened and endangered (T&E) species, historic/archaeological sites, etc.],
  - Engineering considerations (location of roads, sewers, utilities, etc.),
  - "Brownfield" versus "greenfield" sites,
  - Geologic features such as location relative to the Porters Creek Terrace;
- Final criteria
  - Programmatic considerations (time frame for availability of facility in relation to other CERCLA actions, etc.).

The site screening criteria are discussed in detail in Chap. 5.

Conduct screening

The site screening and selection process is an iterative process that applies screening criteria in successive steps to identify final candidate sites. These sites will be further evaluated in the RI/FS. The first step in the screening process is a preliminary screening step. The preliminary screening is a "paper" study using available maps, summary-level review of documents and data, and preliminary interviews with knowledgeable personnel. Sites that fail the threshold criteria are dropped from further consideration.

The screening process consists of the following steps:

- Preliminary screening—reduce the number of candidate sites based on
  - Application of threshold criteria;
- Final screening—reduce number of candidate sites based on:
  - Site inspections/reconnaissance,
  - Intensified review of documents and data,
  - Continued coordination with knowledgeable personnel,
  - Evaluation of modifying and final criteria.

The results of the Preliminary Screening are presented in Chap. 6, and the Final Screening is included in Chap. 7. Final candidate sites remaining after the final screening step are referred to the RI/FS for further evaluation.

Site Identification and Screening Report

The results of the Phase I, Stage 1 evaluations shown in Fig. 1.1 ("Identify Candidate Sites," "Establish Screening Criteria," and "Perform Screening") are presented in this report and will be incorporated into the *RI/FS on Disposal Options for CERCLA-Derived Waste at the PGDP, Paducah, Kentucky* (DOE 2001, to be published). This report describes the three final candidate sites most suitable for evaluation in the RI/FS. The report will be prepared as a D1 document and submitted to the regulatory agencies. Because the results of the report will be incorporated into the D0 draft of the RI/FS, a separate D2 Siting Study Report will not be prepared.

1.2.2 Phase I, Stage 2: Final Site Selection

A field characterization study will be performed at one or more of the final candidate sites as part of the RI/FS to determine the recommended final site for a potential on-site CERCLA waste disposal facility. Field characterization studies (seismic, geotechnical, hydrogeologic, etc.) may include appropriate reconnaissance surveys of potential liquefaction features, geophysical seismic reflection surveys, deep borings with field testing of shear wave velocities and site-specific fault studies. Stage 2 studies would include scoping and preparation of the appropriate work planning documents. The results of the field characterization will be documented in the RI/FS report. Final site selection would be described in the Proposed Plan and the Record of Decision (ROD).

1.2.3 Phase II: Design of a Disposal Facility

Phase II of the site selection process, if appropriate and required, would consist of site characterization that would support remedial design and remedial action. The scope of these tasks would

include any predesign studies, preparation of remedial design work plans, and other tasks associated with facility design. Phase II would proceed only if it appears likely that an on-site CERCLA waste disposal facility would be part of the selected remedy. These tasks may be implemented prior to final ROD signatures, in agreement with the regulators.

2. DESCRIPTION OF POTENTIAL ON-SITE DISPOSAL FACILITY AT PGDP

This chapter describes the conceptual design of a potential on-site CERCLA waste disposal facility. It provides assumptions on the types and volume of waste to be disposed of, minimum area requirements, and liner and cap component details; describes the function of the design component; and reviews the applicable federal or state requirements.

2.1 TYPES OF WASTE ACCEPTED

The types of CERCLA waste designated for disposal in the on-site facility include wastes generated from environmental restoration activities and wastes generated from the D&D of facilities located at PGDP. The wastes generated will include low-level waste (LLW), waste defined under the Resource Conservation and Recovery Act of 1976 (RCRA), waste defined under the Toxic Substances Control Act of 1976 (TSCA), and mixed wastes consisting of combinations of these waste types. In addition, sanitary solid wastes generated during CERCLA activities may be considered for disposal in the facility.

Liquid, transuranic, special LLW, and TSCA wastes exceeding RCRA land disposal restrictions (LDRs) are not considered to be candidate waste streams for the facility. Other excluded wastes include non-CERCLA wastes such as legacy (stored) and operations wastes, and DOE waste generated outside Kentucky.

Preliminary waste acceptance criteria (WAC) will be established in the RI/FS consistent with the methodology used in developing WAC for the EMWMF in Oak Ridge. Final facility-specific WAC for an on-site disposal facility would be developed in conjunction with the regulatory agencies. Only wastes that meet the final facility-specific WAC would be accepted for disposal at an onsite CERCLA waste disposal facility.

2.2 DESIGN VOLUME

The conceptual design of the CERCLA waste disposal facility is based on the facility receiving the following volume of waste, based on an initial assessment of CERCLA waste disposal options at PGDP (DOE 2000a):

• Near-term environmental restoration and D&D wastes	600,000 yd^3
• Future D&D waste	2,500,000 yd^3
• Total waste volume	3,100,000 yd^3

These waste volume estimates will be updated in the RI/FS based upon revisions to relevant site management documents. Different options will be considered in the RI/FS including disposal of a low-end volume based on near-term waste streams only and a high-end volume based on comprehensive waste streams generated over the long term.

2.3 MINIMUM AREA REQUIREMENTS

The conceptual CERCLA waste disposal facility consists of a disposal cell with ancillary facilities to support initial operations and maintenance. The disposal cell would consist of a 3.1M-yd^3 capacity above-grade, earthen cell with a composite cap designed to meet the performance objectives of 40 Code of Federal Regulations (*CFR*) 264.301(c) and 401 Kentucky Administrative Regulations (KAR) 34:230 Section 2(3). Support facilities required for initial operations include those needed for staging, temporary storage, decontamination, and operation and maintenance of the facility (Fig. 2.1). Additional area is required for stormwater management, security, and weighing facilities.

Based on projected waste volumes and cell design assumptions, the disposal facility is estimated to require a total area of approximately 110 acres. The facility footprint includes the following components:

• Area of waste disposal cell only (waste footprint)	30 acres
• Area of containment dike, perimeter roads, and ditches	50 acres
• Area of support facilities	30 acres
• Total Area	110 acres

For the purposes of this siting study, the entire 110-acre footprint has been used in determining minimum area requirements. Using the entire 110-acre footprint instead of the smaller waste disposal cell area to select candidate sites provides flexibility in avoiding problem areas encountered in the final design and site configuration. If the final design calls for flatter side slopes to address issues such as seismic concerns, the 110-acre site will accommodate the increase in waste disposal cell size. The larger footprint will also allow more options for waste disposal cell placement and layout to avoid areas such as transmission lines.

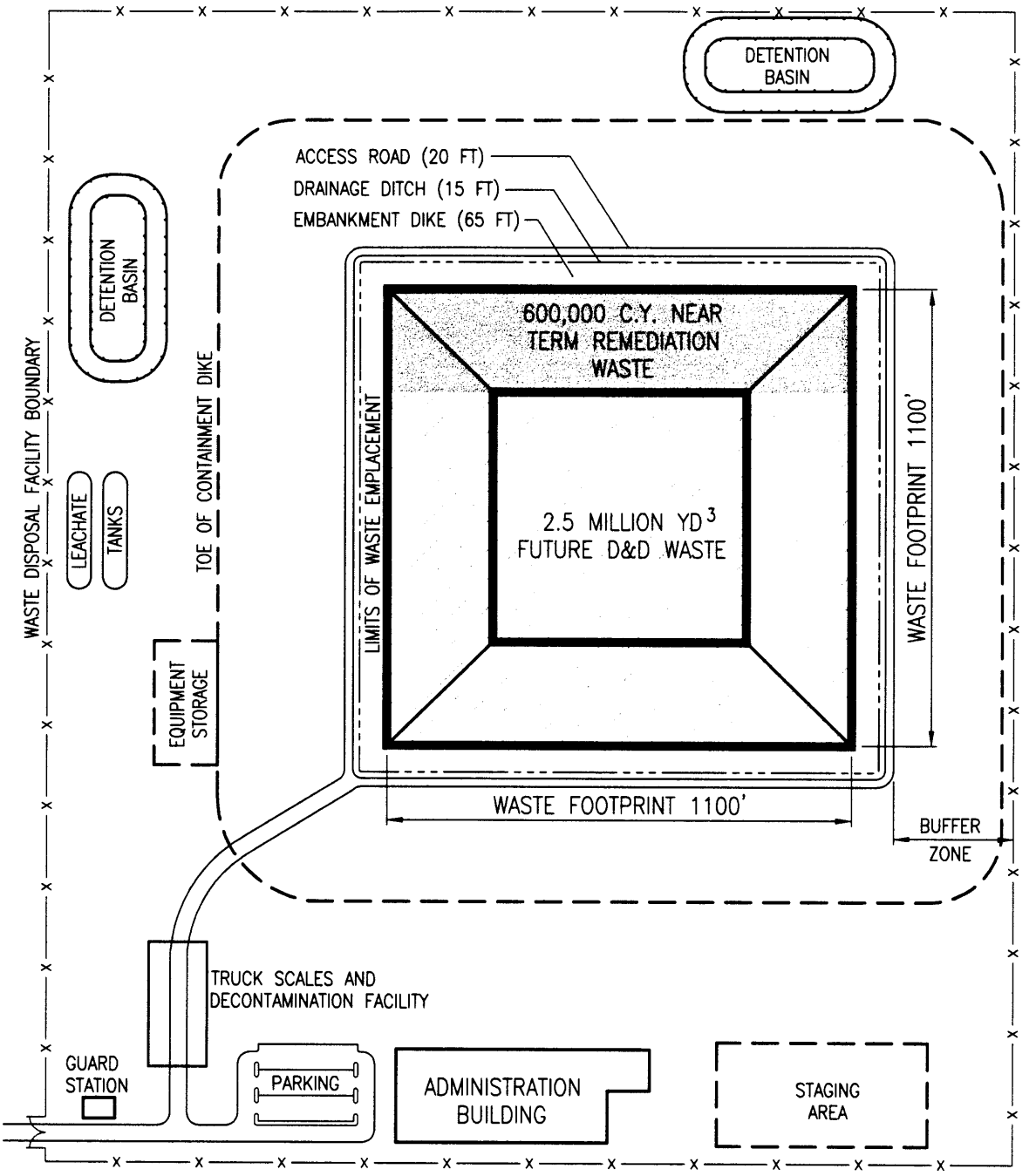
Projected waste volumes and facility area requirements used in this report are based on estimates provided by Bechtel Jacobs Company LLC (BJC), Environmental Restoration and Waste Management (ERWM) Program personnel (DOE 2000a).

2.3.1 Conceptual Design

Conceptual design elements of the on-site waste disposal facility include only the above-grade engineered disposal cell. The support facilities and site development activities have not been included. The engineered disposal cell design basis incorporates the following assumed ARARs:

- attainment of RCRA, TSCA, and LLW regulatory design criteria for disposal of waste;
- effective protection of human health and the environment through waste isolation for up to 1000 years, to the extent reasonably achievable, and, in any case, for at least 200 years (40 *CFR* 192.02);
- protection against animal and plant intrusion, and minimization of the potential for human intrusion;and
- reduction of the potential for incremental and total settlement and slope failure under static and seismic conditions through proper design and waste placement techniques.

Seismic design considerations are being further evaluated in the RI/FS based on discussions with EPA and the Commonwealth of Kentucky. Based on information reviewed to date, it is DOE's conclusion



NOTES:

1.) TOTAL SITE AREA = 110 ACRES.

2.) TOTAL STORAGE CAPACITY = 3.1 MILLION YD^3 (INITIAL ASSESSMENT)

0 200 400

SCALE: 1" = 400'

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR227000
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 2.1. Conceptual site layout.

that seismic considerations are not expected to impact the viability of a waste disposal facility. However, it is possible that future development of seismic design criteria, such as peak ground acceleration, could significantly impact the cost-effectiveness of a potential facility. Site characterization will be implemented during the RI/FS to address these seismic considerations.

2.3.2 Disposal Facility

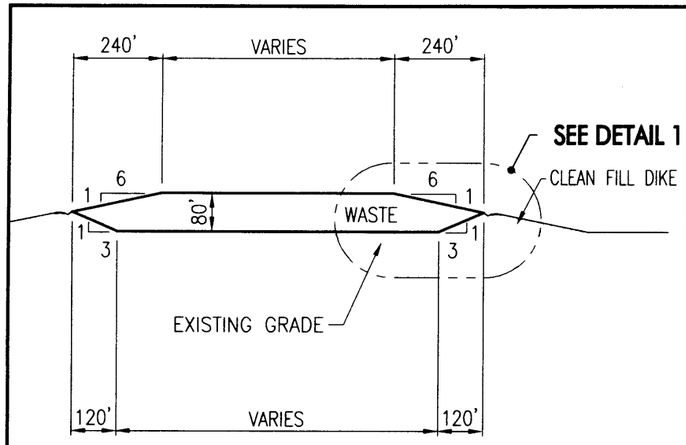
The evaluated disposal facility conceptual design includes a clean-fill perimeter dike; a geologic buffer; a 6-ft thick, multilayer, base liner system consisting of primary and secondary flexible membrane and clay liners, primary and secondary leachate collection/detection systems, and a protective soil layer; and a 16-ft thick, multilayer cap consisting of a low-permeability clay liner, a flexible membrane liner, a drainage layer, a biointrusion layer, and a soil-rock matrix cover (Fig. 2.2).

Clean-Fill Dike. A clean-fill dike would be constructed of suitable soils around the perimeter of the cell. Suitable soils are defined as soils meeting the specific performance requirements of the design. Suitable soils would typically include soils capable of meeting compaction, density, and bearing capacity requirements; would be free of excessive organic materials, debris, or large rock; would not be susceptible to excessive shrinkage, expansion, or erosion; and would meet slope stability requirements. Specific requirements for the soil will be identified in the design and construction specifications if the facility is built. In conjunction with the liner and cover, the clean-fill dike would encapsulate the waste by providing stable lateral containment. The clean-fill dike would also protect against erosion, biointrusion, and inadvertent intrusion by humans or animals. The top of the dike would anchor the liner components, tie into the cover system, and provide for drainage ditches and a perimeter access road. The outer slope would be armored with riprap to prevent erosion.

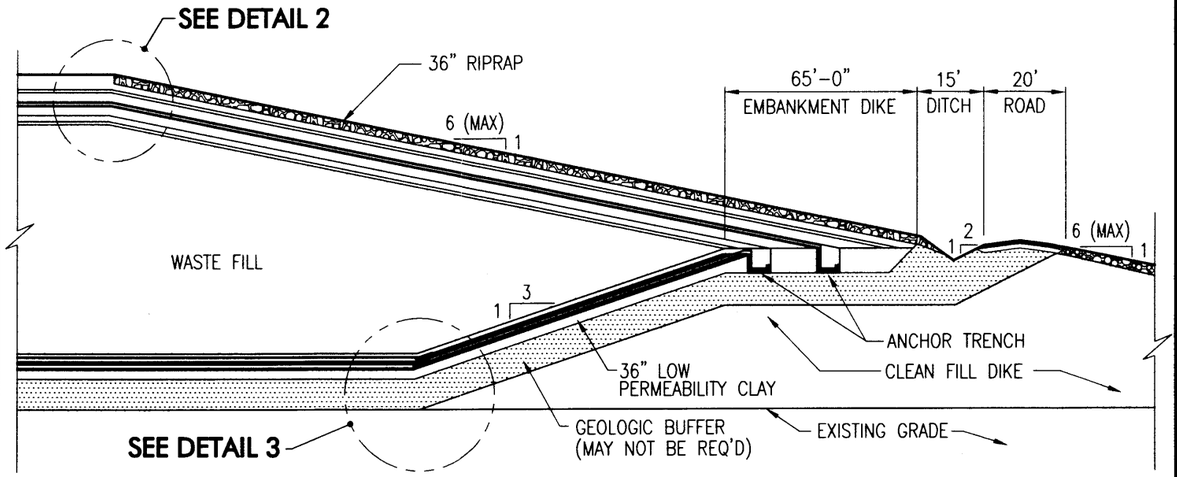
Geologic Buffer. The conceptual design includes a geologic buffer. Geologic buffer is soil, rock, or other natural geologic materials separating the waste disposal unit from an aquifer or other feature. Some regulations, such as TSCA, require that a minimum separation be maintained between waste and the seasonal high water table. The separation is typically referred to as the geologic buffer. The added protection of a geologic buffer constructed of clay fill may be required if the candidate sites contain groundwater at relatively shallow depths. The component may not be required based on site-specific geologic or groundwater conditions and will be evaluated during the detailed cell design.

Multilayer Base Liner System. The purpose of this system is to prevent leachate from migrating out of the disposal unit. A double-liner system is proposed with two low-permeability liners and two leachate collection/detection and removal systems. In accordance with 40 *CFR* 264.301(c) (RCRA hazardous waste disposal regulations), the top (primary) liner would be constructed of materials (e.g., a flexible membrane liner) to prevent the migration of hazardous constituents into such liner during the active life and post-closure care period. The lower (secondary) component of the composite bottom liner would be designed and constructed of materials to minimize the migration of hazardous constituents if a breach in the primary component were to occur. The base liner system proposed for the conceptual design includes the following layers, from the cell base up:

- **Secondary liner:** A flexible membrane liner (FML) and 3 ft of soil material with a hydraulic conductivity $\leq 1 \times 10^{-7}$ cm/s would retard migration of any contaminants or leachate released from the overlying layers. This layer would be placed over the geologic buffer, if the geologic buffer layer is required to provide added protection. The FML would be a man-made geosynthetic barrier composed of materials compatible with the waste and resistant to degradation by the chemical constituents expected to be present in the leachate.



DISPOSAL CELL CROSS SECTION
SCALE: 1" = 400'



DETAIL 1
SCALE: 1" = 50'

GENERAL NOTES:

1.) THE DISPOSAL CELL CROSS SECTION DIMENSIONS LISTED PROVIDE AN APPROXIMATE WASTE STORAGE CAPACITY OF 3.1 MILLION YD^3. THE DISPOSAL CELL IS ESTIMATED TO REQUIRE 80 ACRES, WITH A TOTAL FACILITY FOOTPRINT OF 100–120 ACRES, INCLUDING ROADS AND SUPPORT FACILITIES.

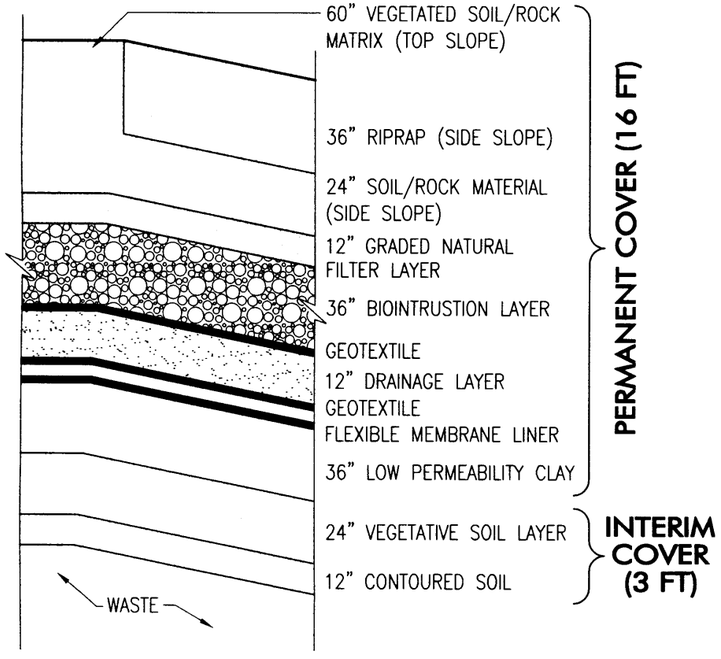
LINER & COVER MATERIAL DESIGN CRITERIA

2.) THE LOW PERMEABILITY CLAY LAYER SHALL HAVE A HYDRAULIC CONDUCTIVITY OF NO MORE THAN 1×10^{-7} cm/sec.

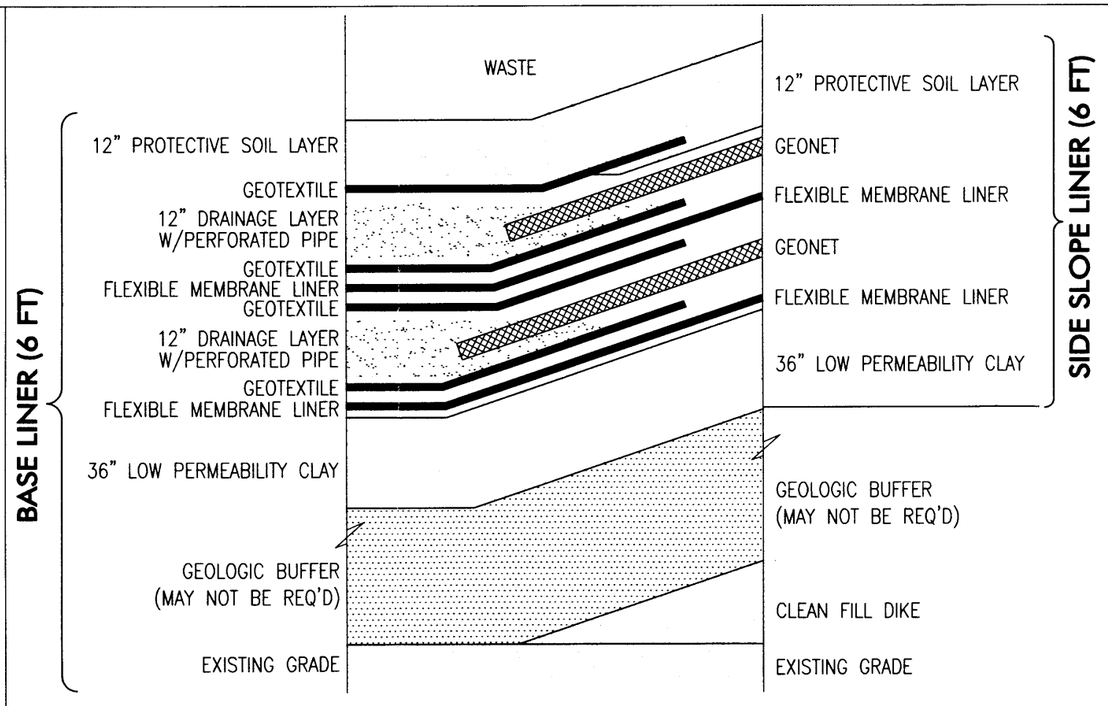
3.) THE DRAINAGE LAYER MATERIALS SHALL HAVE A HYDRAULIC CONDUCTIVITY OF 1×10^{-2} cm/sec.

4.) THE GEONET DRAINAGE MATERIALS SHALL HAVE A TRANSMISSIVITY OF 3×10^{-5} m^2/sec OR GREATER.

5.) THE FLEXIBLE MEMBRANE LINER MATERIALS SHALL HAVE A DEMONSTRATED HYDRAULIC CONDUCTIVITY LESS THAN 1×10^{-12} cm/sec.



DETAIL 2
NOT TO SCALE



DETAIL 3
NOT TO SCALE

Fig. 2.2. Conceptual cross-section of disposal cell.

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-98OR227000
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications
International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

- **Secondary leachate detection layer:** A 1-ft gravel leachate detection layer sandwiched between two geotextile layers would collect any leachate that penetrates the primary liner. This layer would be graded to drain toward detection piping. The detection piping would be connected to a separate detection sump in the leachate collection and transfer facility downgradient of the disposal cell. Little or no leachate is expected to be captured by this system during the operations or postclosure periods.

- **Primary liner:** The primary liner would retard leachate migration out of the disposal cell and direct leachate into the primary leachate collection layer. This layer would include an FML and is designed to prevent the migration of hazardous constituents into the secondary leachate detection layer.

- **Primary leachate collection layer:** The primary leachate collection layer consists of a gravel layer at the base of the cell and highly permeable geonet along the sloping walls. The 1-ft gravel leachate collection layer sandwiched between two layers of geotextile at the base of the cell would collect significant volumes of leachate during operations and before placement of the cap, and small volumes of leachate during the postclosure period. The geotextile layers would cushion and protect the primary liner and retard infiltration of fines from the overlying soil and waste into the gravel to prolong the functional life of the leachate recovery system. Perforated leachate collection pipes would be placed in the gravel drainage layer and would transfer leachate by gravity to a collection sump in the leachate collection and transfer facility. On the sloping (3 horizontal to 1 vertical) walls of the facility, a geonet (a plastic grid sandwiched between two layers of geotextile with triple the flow capacity of gravel) would be used to transmit leachate to the gravel leachate collection layer on the cell base.

- **A 1-ft thick protective soil layer:** A protective soil layer at least 1-ft thick would be placed over the upper leachate collection geotextile to prevent damage during operations.

Permanent Cover. In accordance with 40 *CFR* 264.310 (RCRA hazardous waste land disposal regulations), the final cover would be designed and constructed to

- minimize migration of liquids through the closed disposal cell over the long term;

- promote drainage and minimize erosion or abrasion of the cover;

- accommodate settling and subsidence to maintain the cover's integrity;

- provide a permeability less than or equal to the permeability of any bottom-liner system or natural subsoils present;

- resist intrusion of humans, plants, and animals; and

- function with minimal maintenance.

The cover would be sloped to facilitate runoff and would be placed over the waste and the top of the clean-fill dike. The conceptual design for the 16-ft thick cover consists of the following elements, from bottom to top:

- **Interim cover:** Following placement of waste to final grade in any area, an interim cover would be placed over the waste to minimize infiltration and contain the waste before closure. The interim cover would include a 1-ft minimum, clay-contour soil layer to provide an intermediate uniform layer between the wastes and the final cover. This cover would bring the disposal cell to final grade in preparation for cover placement, reduce infiltration, and protect the permanent cover layer from

settlement within the waste cell. A 2-ft vegetative soil layer would be placed and seeded above the contour soil layer to reduce erosion before placement of the final cover.

- **Secondary hydraulic barrier:** During final closure, a 3-ft thick, low-permeability clay layer would be placed above the interim cover. This layer is considered the secondary hydraulic barrier and would be similar in design to the low-permeability clay layer of the secondary base liner.

- **Primary hydraulic barrier:** Above the low-permeability soil layer would be an FML. The FML would serve as an additional low-permeability layer and would prevent infiltration into the cell.

- **Drainage layer:** Above the FML would be a 1-ft gravel drainage layer sandwiched between two layers of geotextile. The upper geotextile would minimize clogging of the drainage layer and the lower geotextile would protect the FML from puncture.

- **Biointrusion layer:** A 3-ft biointrusion layer would prevent burrowing animals and plant root systems from penetrating the cover system and would discourage inadvertent intrusion by humans by increasing the difficulty of digging or drilling into the cell. This layer would be constructed of cobbles (large, 3–12 inch in diameter rounded stones) or cobble-size riprap (large, angular stones) and would facilitate infiltration of water into the drainage layer. A 12-inch graded natural filter would overlie the biointrusion layer to prevent clogging of the porous layer with the overlying soil.

- **Erosion prevention layer:** A 5-ft vegetated soil-rock matrix over the disposal cell (at a 3 to 5% grade) would protect the disposal cell layers from the effects of wind and water erosion. This layer would accommodate the typical root systems of planted and native vegetation. This layer, the drainage layer, and the biointrusion layer together would be much thicker than the local frost depth, preventing frost damage to the FML and the low-permeability soil layer. Side slopes of the cover system would be covered with a 2-ft soil-rock matrix and a 3-ft riprap layer to minimize erosion.

The overall effectiveness of the permanent cover in reducing infiltration is the key to cell performance and can be increased through a variety of technical measures. The effectiveness of individual drainage layers can be increased, the number of drainage layers can be increased, the effective flow distance can be reduced, and the effectiveness of underlying low-permeability layers can be increased. Technical means for accomplishing these improvements include material substitution, addition of clay modifiers to reduce permeability, and the use of geosynthelic clay liners. Cover technology is evolving and additional methods for reducing infiltration may be available at the time of final design. The overall goal is to reduce leachate generation through the reduction of infiltration.

3. ENVIRONMENTAL SETTING

This chapter describes the environmental setting at PGDP and within the surrounding DOE-owned property . The information in this chapter specifically describes site conditions relative to geography and physiography, demography and land use, climatology and meteorology, geology, hydrology, and ecological resources. An awareness and understanding of these important siting conditions are essential to systematically identify and subsequently screen candidate sites in the following chapters of this document.

3.1 GEOGRAPHY AND PHYSIOGRAPHY

PGDP is located in western McCracken County, Kentucky, about 3 miles south of the Ohio River and approximately 10 miles west of the city of Paducah (Fig. 3.1). Approximately 90% of the area within a 5-mile radius of the plant is agricultural or forested land. Urban and industrial lands comprise less than 4% of the surrounding area, and surface water bodies cover approximately 5% (MMES 1993).

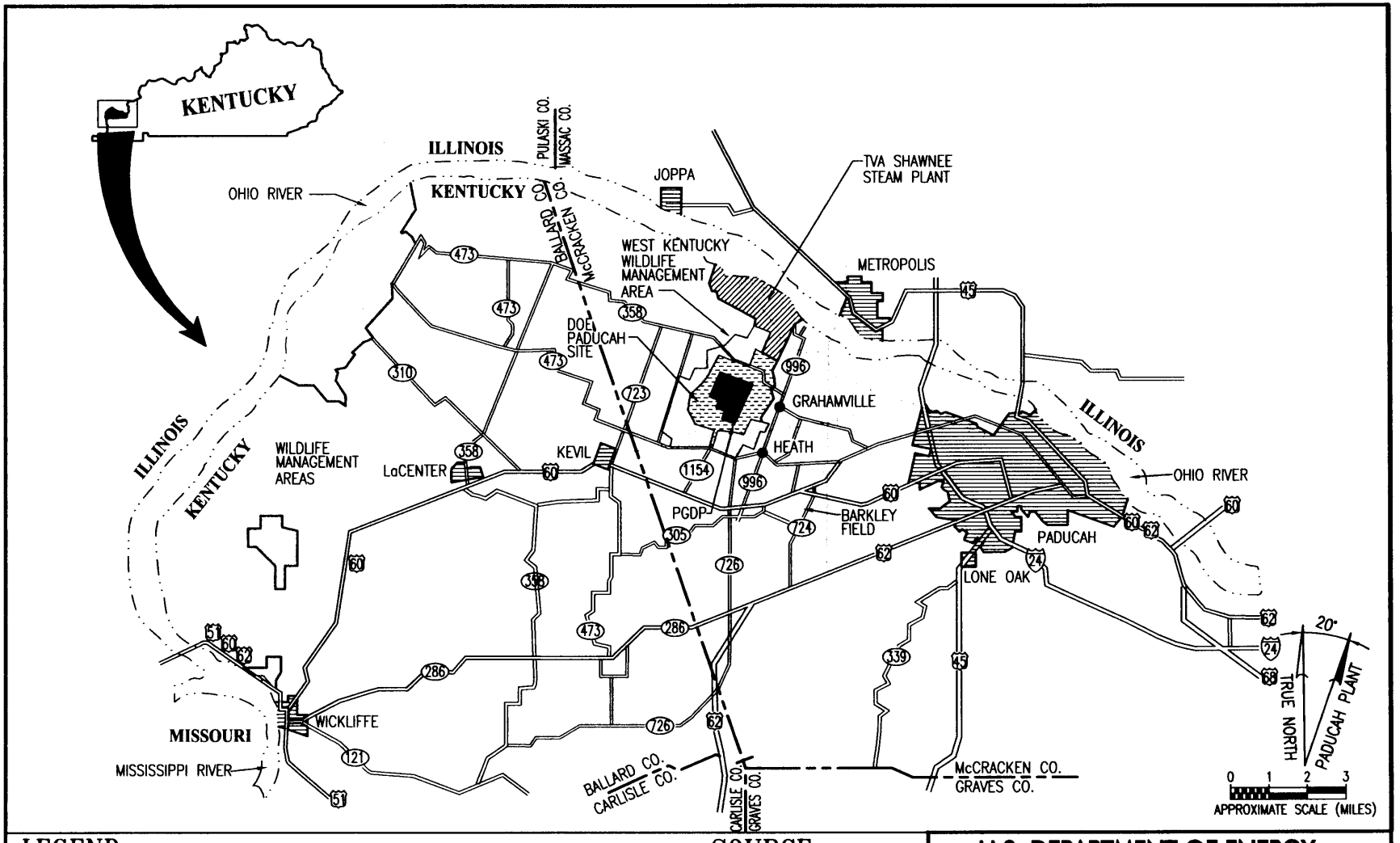
PGDP is located in the Jackson Purchase Region of western Kentucky, at the northern tip of the Mississippi embayment portion of the Atlantic Coastal Plain physiographic province. The area is bounded on the north and east by the Highland Rim portion of the Interior Low Plateau physiographic province, an area of low plateaus on stratified sedimentary rock. The Mississippi Embayment is a large sedimentary trough oriented north–south that received sediments from the middle of the North American continent.

The Paducah Site is situated in an area characterized by low relief. Elevations vary from about 350 to 390 ft above mean sea level (amsl), with the ground surface sloping at a rate of approximately 27 ft/mile toward the Ohio River. Two main topographic features dominate the landscape in the surrounding area: the loess-covered plains at an average elevation of 390 ft amsl, and the Ohio River floodplain zone, dominated by alluvial sediments, at an average elevation of 315 ft amsl (Humphrey 1976). The terrain of the PGDP area is modified slightly by the dendritic drainage systems associated with the two principal streams in the area, Bayou Creek and Little Bayou Creek. These northerly flowing streams have eroded small valleys that are approximately 20 ft below the adjacent plain.

3.2 DEMOGRAPHY AND LAND USE

3.2.1 Land Use

The total amount of land held by the DOE at the Paducah Site is 3556 acres. The industrial portion of PGDP is situated within a fenced security area consisting of approximately 748 acres. Within this area, designated as secured (i.e., fenced and patrolled) industrial land use, are numerous buildings and offices, support facilities, equipment storage areas, and active and inactive waste management units. Outside the fenced security area is approximately 1986 acres of land that the DOE leases to the Commonwealth of Kentucky through the Kentucky Department of Fish and Wildlife (KDFW) as part of the West Kentucky Wildlife Management Area (WKWMA). The entire WKWMA covers approximately 6823 acres. The land leased to the WKWMA is designated as recreational and is used extensively for outdoor recreation such as hunting and fishing. In addition to the lease agreement with the KDFW, DOE currently holds lease agreements with the United States Enrichment Corporation (USEC) for the production facilities at PGDP. The remaining portions of the Paducah Site consist of approximately



LEGEND:

- WILDLIFE MANAGEMENT AREA
- PADUCAH GASEOUS DIFFUSION PLANT (PGDP)
- DEPARTMENT OF ENERGY (DOE) PADUCAH SITE
- MUNICIPALITY
- TENNESSEE VALLEY AUTHORITY (TVA)
- APPROXIMATE LOCATION OF RAILROADS IN AREA (REDRAWN FROM MICROSOFT STREETS AND TRIPS 2000)
- RIVER

SOURCE:

JACOBS ENGINEERING 1996.

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 3.1. PGDP vicinity map.

689 acres of land owned and maintained by DOE outside of the secured area that are not part of the WKWMA and 133 acres of easements acquired by DOE (DOE 1998).

Further, portions of both the Paducah Site and WKWMA occupy land that once was part of the Kentucky Ordnance Works (KOW), a trinitrotoluene (TNT) production facility in operation between 1942 and 1946.

Figure 3.2 details the current land use surrounding PGDP. This land use designation is consistent with the SMP (DOE 2000b). PGDP is designated as on-site secured (i.e., fenced) industrial land use. The DOE-owned property outside the security area that is not part of the WKWMA is designated as on-site, unsecured (i.e., not fenced) industrial land use. The DOE-owned property that is part of the WKWMA is designated as recreational land use. The WKWMA is also designated recreational land use. North of the Paducah Site, the Tennessee Valley Authority (TVA) operates Shawnee Steam Plant. This TVA property is designated as industrial land use.

Surrounding the Paducah Site, WKWMA, and TVA is private property. This property is primarily rural residential and agricultural. In the vicinity of PGDP, the main crops include soybeans, corn, and various grain crops. Other foods grown in the area include persimmons and apples. A variety of small gardens also are present where tomatoes, squash, beans, peppers, okra, potatoes, and other vegetables are grown (CH2M HILL 1991a). In addition, 26% of the total land area of Ballard County and 24% of McCracken County are designated as commercial forestland.

DOE began preliminary discussions with stakeholders on future land use during a public workshop at Paducah in 1994. The subject has been discussed at various meetings with the PGDP Neighborhood Council, the PGDP Environmental Advisory Committee, city and county officials, economic development interests, and the Site-Specific Advisory Board. In general, the majority of the stakeholders supported a continued industrial-commercial presence at the site that would preserve existing jobs and continue to contribute to the regional economy (DOE 2000a). Therefore, no significant changes to land use, as outlined, are expected in the future.

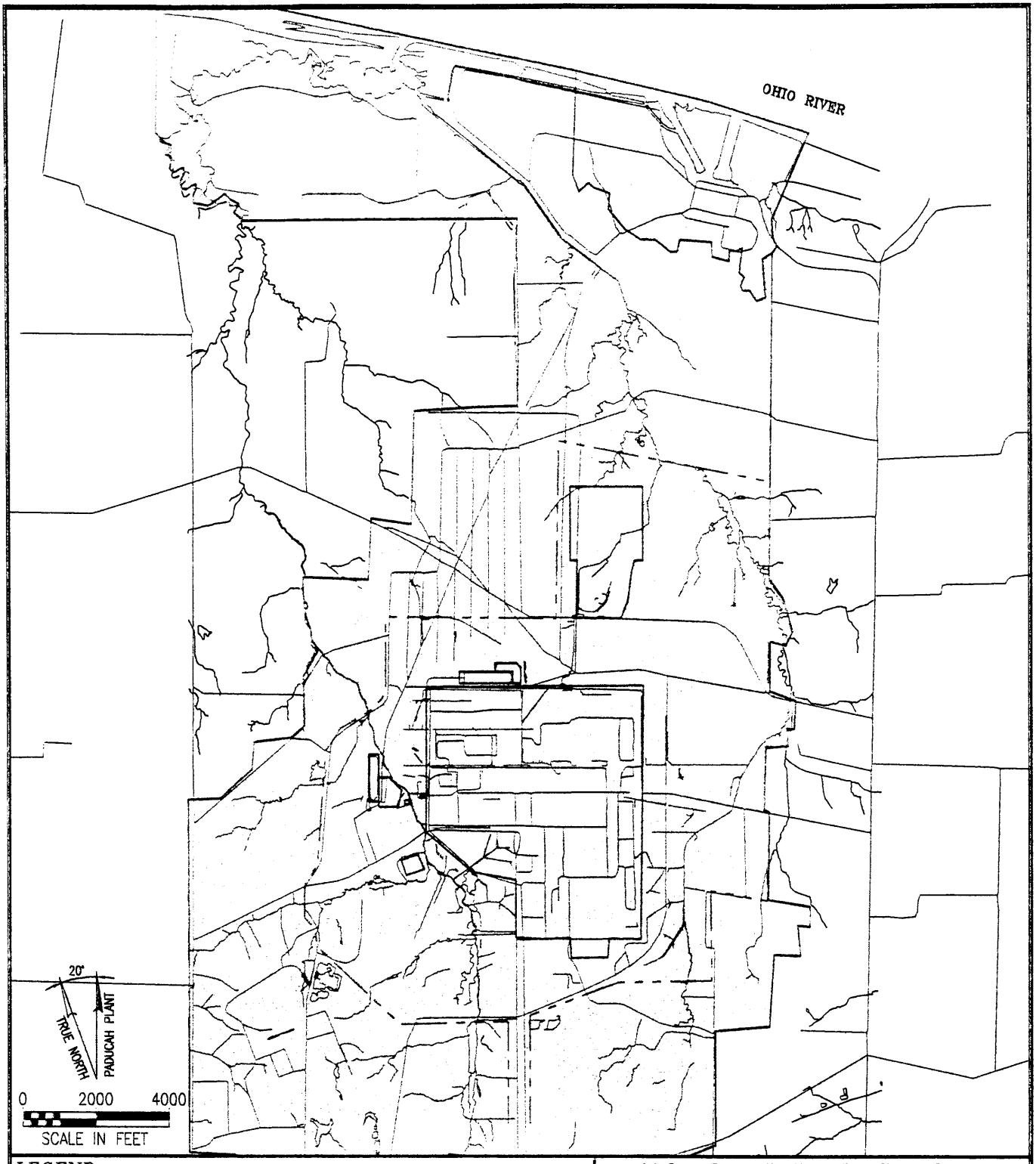
3.2.2 Population

The largest city within a 50-mile radius of the plant is Paducah, Kentucky, located approximately 10 miles east of the plant. The population of the city of Paducah in 1990 was 27,256 and was estimated to be 25,883 in 1998 (Encarta 2000).

The total population within a 50-mile radius of the plant was estimated at 500,000, with approximately 66,000 people residing within a 10-mile radius of PGDP (DOC 1994). The population of McCracken County, as of July 1995, was reported as 64,577 persons. Counties adjacent to McCracken in closest proximity to the plant reported the following populations: Ballard County, Kentucky, 8,232; and Massac County, Illinois, 15,370 (DOC 1995). Several small communities are within 5 miles of the plant boundaries. The closest communities, both unincorporated, are Grahamville and Heath, located 1 to 2 miles east of the plant. The closest communities that have public water supplies are Kevil, Kentucky, and Metropolis, Illinois.

3.2.3 Socioeconomics

PGDP is a major western Kentucky industry, employing about 2200 people (BJC 2000). TVA Shawnee Steam Plant, to the northeast, employs approximately 500 workers. This TVA plant is the only



LEGEND:
- INDUSTRIAL
- RECREATIONAL
- RURAL RESIDENTIAL
- DOE BOUNDARY
- STREAMS

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 3.2. Land use for PGDP and surrounding area.

other active major industrial facility in the immediate vicinity of PGDP. An Allied Signal plant located across the Ohio River near Metropolis, Illinois, supplies UF_6 to PGDP for processing.

McCracken County's employment was recorded at 34,523 persons in June 1999, with unemployment recorded as 1368 persons, or 4% (KCWD 1999). In 1998 in the Purchase Area of Kentucky, which includes the counties of Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, McCracken, and Marshall, construction accounted for 15% of employment, manufacturing accounted for 34%, mining accounted for 14%, services accounted for 13%, and trade accounted for 15% (KCWD 1998). The average 1993 per capita income in McCracken County was $19,647 as compared to 1994 averages of $17,807 per capita in Kentucky and $21,809 in the United States (DOC 1995).

For the purposes of this discussion, a minority population consists of any area in which minority representation is greater than the national average of 24.2%. Minorities include individuals classified by the U.S. Bureau of the Census as Negro/Black/African-American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, or Aleut. Since Hispanics may be of any race, nonwhite Hispanics are included only in the Hispanic category, and not under their respective minority racial classifications.

The demographics of the area surrounding PGDP, with respect to income level and minority status, were evaluated in detail in the *Waste Management Programmatic Environmental Impact Statement* (DOE 1997c). Overall, the population in a 50-mile radius of PGDP does not contain a higher minority representation than the national average. The highest minority representation was 5.2% in a tract in McCracken County (Bureau of the Census 1990a). There are no federally recognized Native American tribes in the area. The *Waste Management Programmatic Environmental Impact Statement* did determine that a higher percentage than the national average of the population surrounding PGDP qualified as low income. A low-income population includes any census tract in which the percentage of persons with income below the poverty level is greater than the national average of 13.1% (Bureau of the Census 1990b). Of the tracts closest to PGDP, three show percentages of low-income populations above the national average; approximately 17% of each of these populations is low income. Two of these tracts are directly across the Ohio River in Massac County, Illinois; the third is west of PGDP in Ballard County, Kentucky (Bureau of the Census 1990a).

3.2.4 Cultural Resources

The 1994 U.S. Army Corps of Engineers (COE) survey of cultural resources near PGDP located and reported 11 sites and 12 localities. These sites include four prehistoric sites showing limited activity, three Archaic open habitation sites, and four historic homestead sites. Two of the 11 sites discovered are adjacent to and just outside the DOE property boundary.

Sites dating from recent times are of poorer quality than those from eras prior to European colonization of North America. The quality of all four identified homestead sites is poor. Two of the homestead sites date from near the time of the Civil War, while the other two homesteads are more recent, originating in the early 1900s. Prehistoric sites, those dating to the Pleistocene (10,000–12,000 years ago), are in good condition but occupy relatively small areas and contain only a few broken points or scattered flakes. Therefore, it was determined that they did not warrant National Register of Historic Places (NRHP) status. All three open habitation sites date from the Archaic and/or Mississippian period, an era ranging between 8000 B.C. and 500 A.D., and have the greatest potential for listing on the NRHP. In general these sites occupy relatively large areas, and shovel tests showed cultural material was deposited well below the surface, indicating at least moderate use over a long period of time.

Additionally, sites of cultural interest near PGDP include the KOW, located primarily southwest of the DOE-owned property, and Harmony Cemetery, located just north of the PGDP security fence.

3.2.5 Transportation

There are four federal highways (U.S. 45, 60, 62, and 68) and one interstate highway (I-24) in the vicinity of PGDP. Highway 60 is used most frequently by plant personnel for access to PGDP. The estimated daily traffic count for Highway 60 was 9560 between Highways 305 and 996 and 7700 between the county line and Hobbs Road (plant Access Road) for the year 2000 [Kentucky Transportation Cabinet (KYTC) 2000]. This portion of Highway 60 is functionally classified as "rural—principal arterial."

Because PGDP is located in a secured area, traffic is minimal within the plant and surrounding area and is limited generally to vehicles traveling into or out of two gates. Vehicles are screened by security before entering the secure area of the plant. Traffic within PGDP generally is limited to trucks and service vehicles that must move equipment and supplies within the facility. Traffic within DOE-owned property consists chiefly of infrequent visits by recreationists, PGDP personnel, and WKWMA personnel traveling on existing gravel roads in the area. Ogden Landing Road, Highway 358 shown in Fig. 3.1, is the only road frequently used by the public within the DOE-owned property boundary . The estimated traffic daily count for Highway 358 was 1070 west of PGDP and 1240 east of PGDP for the year 2000 (KYTC 2000).

The railways within DOE property, south to Woodville Road, are owned by DOE and maintained by USEC. These railways connect to the Paducah & Louisville Railway, Inc., rail lines and travel east to the rail yard in Paducah, VMV Enterprise. From the rail yard, connections are available to Burlington Northern, Canadian National, and Louisville & Nashville. Rail traffic near PGDP is minimal.

The closest commercial airport is Barkley Regional Airport, which is located approximately 5 miles southeast of PGDP. Barkley Regional Airport is jointly owned by the city of Paducah and McCracken County and operated by the Paducah Airport Corporation. More than 150 people are employed at the airport with a $22 million annual economic impact on the local economy. The airport's marketing area is a 60-mile radius surrounding the airport and represents a population of approximately 300,000 persons (Barkley Regional Airport 2000).

3.3 CLIMATOLOGY AND METEOROLOGY

3.3.1 Climate

The climate of the PGDP area can be described as humid-continental. It is characterized by warm and humid summers and moderately cold and humid winters. Temperatures for the summer months average 29.4 °C (85 °F), while winter temperatures average 2.2 °C (36 °F). During the winter months, temperatures drop below freezing an average of 60 nights and 10 days. The summers average 40 days per year of 32 °C (90 °F) or higher temperatures. The climate of the Paducah area is very similar to that of Oak Ridge, Tennessee (also classified as humid-continental), and to that of the Weldon Springs Site near St. Louis, Missouri (classified as continental).

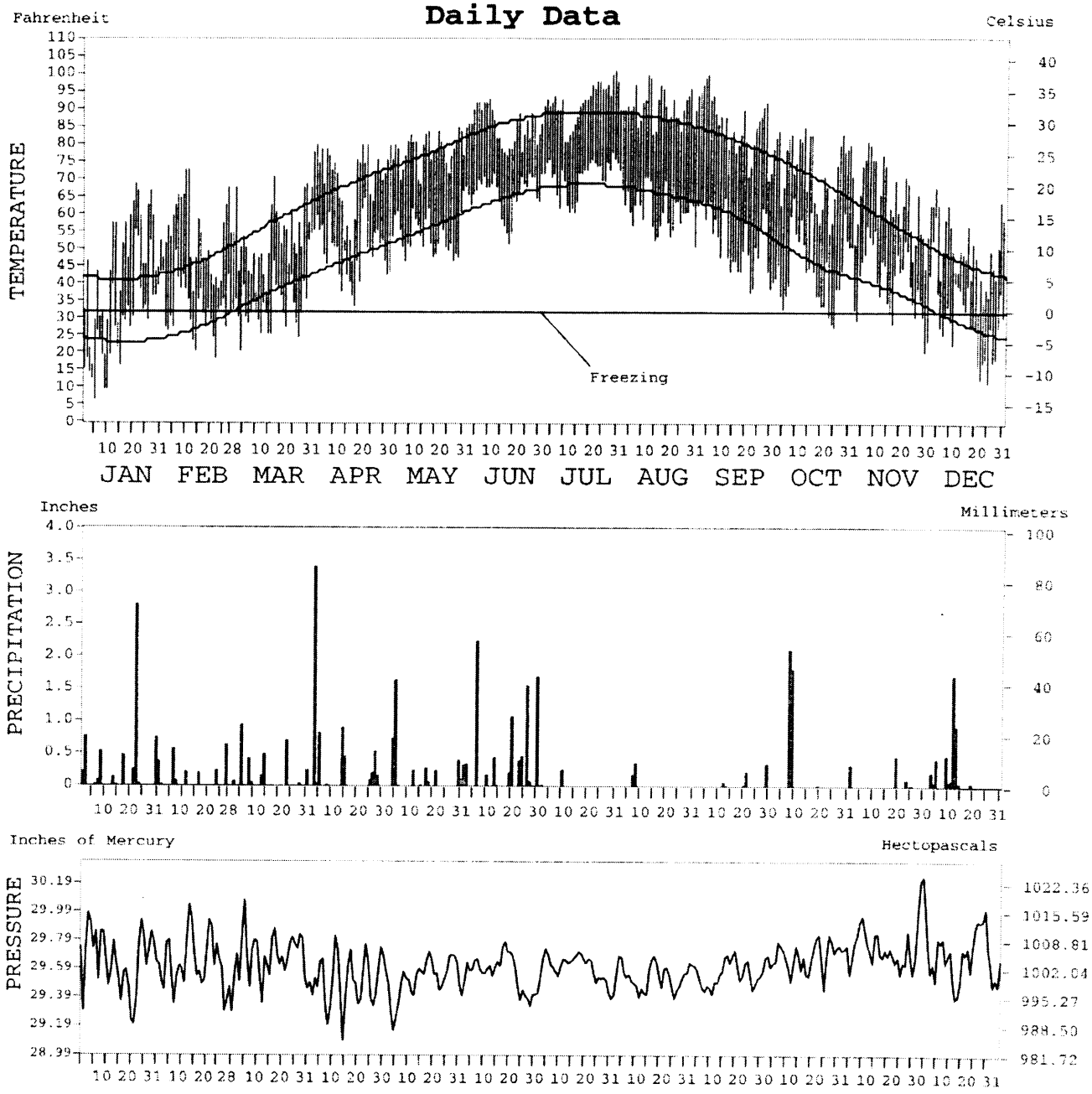
Precipitation is distributed relatively evenly throughout the year and averaged 50 inches per year from 1969 to 1989 (CH2M HILL 1992). The average annual precipitation for the region from 1984 to 1999 was 47.84 inches per year (NCDC 2000). Maximum precipitation during this time was 65.13 inches in 1984; the minimum was 36.36 inches in 1987. Most groundwater recharge and stream flooding occur between November and May, when evapotranspiration normally is less than the remainder of the year.

1999 LOCAL CLIMATOLOGICAL DATA
ANNUAL SUMMARY WITH COMPARATIVE DATA

ISSN 0888-9988

PADUCAH,
KENTUCKY (PAH)

Daily Data



SOURCE: NCDC 2000

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS
Bechtel Jacobs Company LLC

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-980R227000
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Fig. 3.3. Summary of Paducah climatological data.

SAIC
Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

The average prevailing wind in the area is from the south to southwest at approximately 9.8 mph. Generally, stronger winds are observed when the winds are from the southwest or northwest.

Since 1950, there has been a total of eight reported tornadoes in McCracken County. None of these tornadoes resulted in a fatality.

3.3.2 Air Quality

PGDP is located in the Paducah-Cairo Interstate Air Quality Control Region of Kentucky, which includes McCracken County and 16 other counties in western Kentucky. Data from the state's air monitors are used to assess the region's ambient air quality for the criteria pollutants (ozone, nitrogen oxides, carbon monoxide, particulates, lead, and sulfur dioxide) and to designate nonattainment areas (i.e., those areas for which one or more of the National Ambient Air Quality Standards are not met). McCracken County is classified as an attainment area for all six criteria pollutants (KEQC 1992). Recent monitoring, however, shows the area potentially is in violation of smog standards (*Paducah Sun* 2000).

In addition, PGDP operates an ambient air monitoring system to assess the impact of various air contaminants emitted by PGDP on the surrounding environment. Ambient air monitoring of gaseous fluorides and radioactive particulates (gross alpha and gross beta) is accomplished by 12 continuous samplers (four fence line and eight off-site) (MMES 1993). The off-site ambient concentrations of fluorides at PGDP in 1994 were well below the air quality standards set by the EPA (40 *CFR* §61.90) and the Kentucky Department of Environmental Protection (KDEP), Division for Air Quality. Six additional ambient air sampling stations (one inside the plant, two on DOE property, and three off-site) went into operation during July 1995.

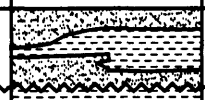
3.3.3 Noise

Noises associated with plant activities generally are restricted to areas inside buildings located on-site. Noise levels beyond the security fence are limited to wildlife, hunting, traffic moving through the area, and operation and maintenance activities associated with outside waste storage areas located close to the security fence.

3.4 GEOLOGY

The subsurface in the PGDP vicinity consists of approximately 350 ft of Cretaceous, Tertiary, and Quaternary sediments unconformably overlying Paleozoic bedrock. In the PGDP vicinity, these sediments dip gently to the south-southwest toward the axis of the Mississippi Embayment and overlie northward-dipping Paleozoic bedrock. In stratigraphic order, bedrock is overlaid by the rubble zone, the Tuscaloosa Formation, the McNairy Formation, the Paleocene Porters Creek Clay, undifferentiated Eocene sediments, and Pliocene and Pleistocene continental deposits (Fig. 3.4).

The erosion and subsequent fill of the ancestral Tennessee River Valley during the Pleistocene is a primary factor controlling the geologic units beneath PGDP. During the Pleistocene, the ancestral Tennessee River occupied a position close to the present-day course of the Ohio River. The southern edge of the former Tennessee River Valley underlies PGDP. Figure 3.5 presents a general north-south cross-section of the geologic units extending from PGDP to the Ohio River.

SYSTEM	SERIES	FORMATION	LITHOLOGY	THICKNESS (IN FEET)	DESCRIPTION
QUATERNARY	PLEISTOCENE AND RECENT	ALLUVIUM		0-40	Brown or gray sand and silty clay or clayey silt with streaks of sand.
	PLEISTOCENE	LOESS		0-43	Brown or yellowish-brown to tan unstratified silty clay.
	PLEISTOCENE	CONTINENTAL DEPOSITS		3-121	Clay Facies - mottled gray and yellowish brown to brown clayey silt and silty clay, some very fine sand, trace of gravel. Often micaceous.
	PLIOCENE-MIOCENE (?)				Gravel Facies - reddish-brown clayey, silty and snady chert gravel and beds of gray sand.
TERTIARY	EOCENE	JACKSON CLAIBORNE AND WILCOX FORMATIONS		0-200+	Red, brown or white fine to coarse grained sand. Beds of white to dark gray clay are distributed at random.
				0-100+	White to gray sandy clay, clay conglomerates and boulders, scattered clay lenses and lenses of coarse red sand. Black to dark gray lignitic clay, silt or fine grained sand.
	PALEOCENE	PORTERS CREEK CLAY		0-200	Dark gray, slightly to very micaceous clay. Fine grained clayey sand, commonly glauconitic in the upper part. Glauconitic sand and clay at the base.
		CLAYTON FORMATION		Undetermined	Lithologically similar to underlying McNairy Formation.
UPPER CRETACEOUS		McNAIRY FORMATION		200-300	Garyish-white to dark gray micaceous clay, often silty, interbedded with light gray to yellowish-brown very fine to medium grained sand with lignite and pyrite. The upper part is interbedded clay and sand, and the lower part is sand.
		TUSCALOOSA FORMATION		Undetermined	White, well rounded or broken chert gravel with clay.
MISSISSIPPIAN		MISSISSIPPIAN CARBONATES		500+	Dark gray limestone and interbedded chert, some shale.

SOURCE: Jacobs 1995

Not To Scale

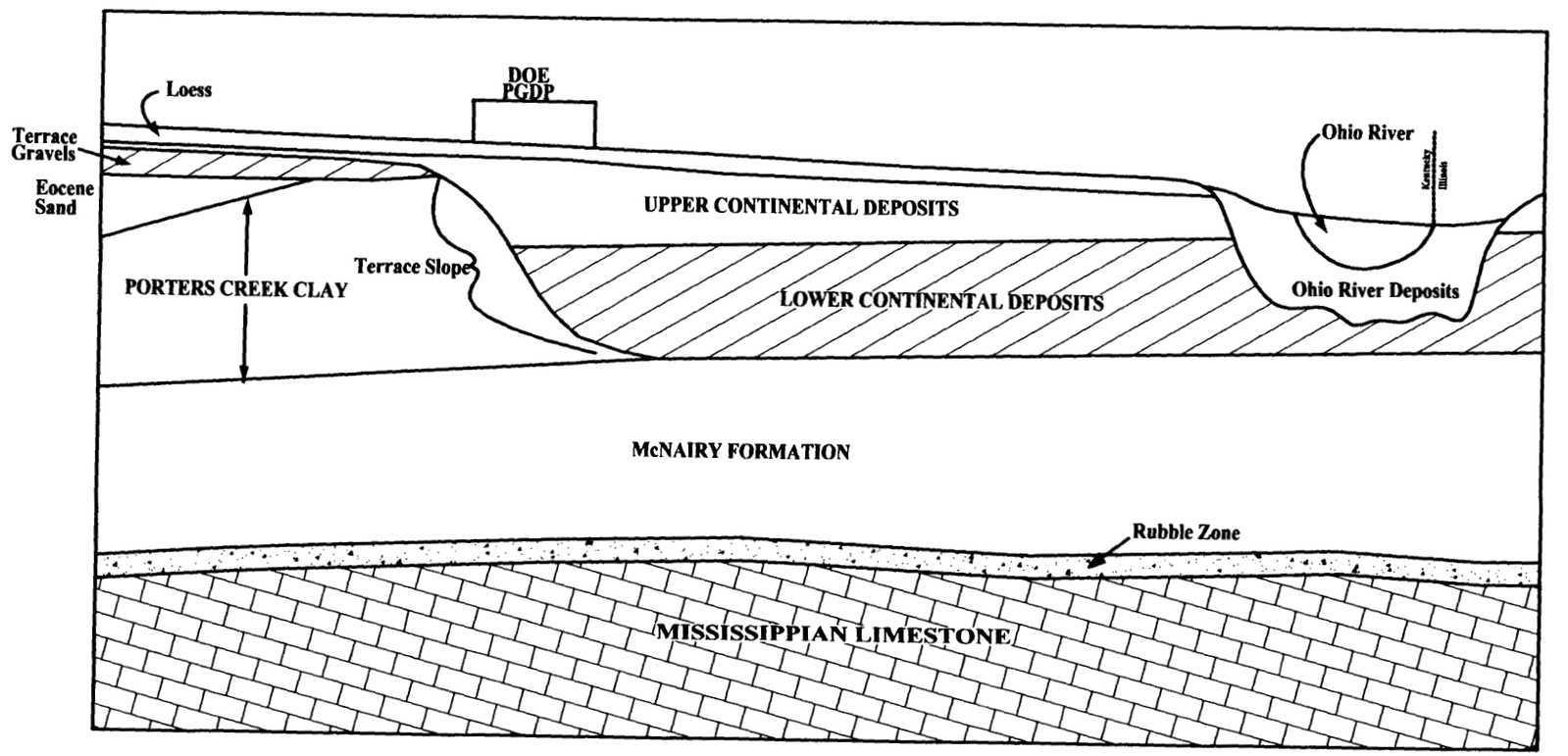
Fig. 3.4. Columnar section of the Jackson Purchase Region.

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR227000
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

DOCUMENT No. /99049/DWGS/L63XSEC



U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS
BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

SAIC
Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 3.5. Geologic cross-section of PGDP area.

3.4.1 Bedrock

Deep borings at PGDP have encountered Mississippian limestone bedrock approximately 335 to 350 ft below ground surface. Immediately overlying bedrock at PGDP is the rubble zone, which consists of a 5- to 20-ft thick layer of subangular chert and silicified limestone fragments.

3.4.2 McNairy and Clayton Formations

Overlying the rubble zone are the unconsolidated deposits of the Upper Cretaceous McNairy Formation. This formation is composed of interbedded and interlensing sand, silt, and clay. The sands are well-sorted, fine-grained, micaceous, and commonly glauconitic (common rock-forming minerals). Near PGDP, the McNairy Formation can be subdivided into three lithologic members: (1) a 60-ft thick sand-dominant lower member; (2) a 100- to 130-ft thick middle member composed predominantly of silty and clayey fine sand; and (3) a 30- to 50-ft thick upper member consisting of interbedded sands, silts, clays, and occasional gravels. Overlying the McNairy deposits are deposits of the Clayton Formation. Because of difficulties in distinguishing between the Clayton and McNairy Formations at PGDP, these lithologies have been grouped together and termed the McNairy Formation. Total thickness of the McNairy Formation is approximately 225 ft.

3.4.3 Porters Creek Clay

Overlying the McNairy Formation, the Paleocene Porters Creek Clay occurs in southern portions of the site as a massive, glauconitic clay with lesser interbeds of sand. A terrace slope of the ancestral Tennessee River completely cuts through the thickness of the Porters Creek Clay under the south end of PGDP (Fig. 3.6). The Porters Creek Clay is approximately 100-ft thick immediately southwest of PGDP but is absent, or present only as thin isolated remnants, to the north of the terrace slope.

Outcrops of the Porters Creek Clay on DOE property are limited to a few isolated locations in the bed of Bayou Creek and its tributaries. However, borehole data are sufficient to show that the top of the Porters Creek Clay south of PGDP has significant topographic relief. Immediately south and west of PGDP, the high elevation of the top of the Porters Creek Clay limits the development of a shallow groundwater system in that area. A greater depth to the top of the Porters Creek Clay to the east of PGDP permitted deposition of a relatively permeable Pliocene gravel deposit near the surface.

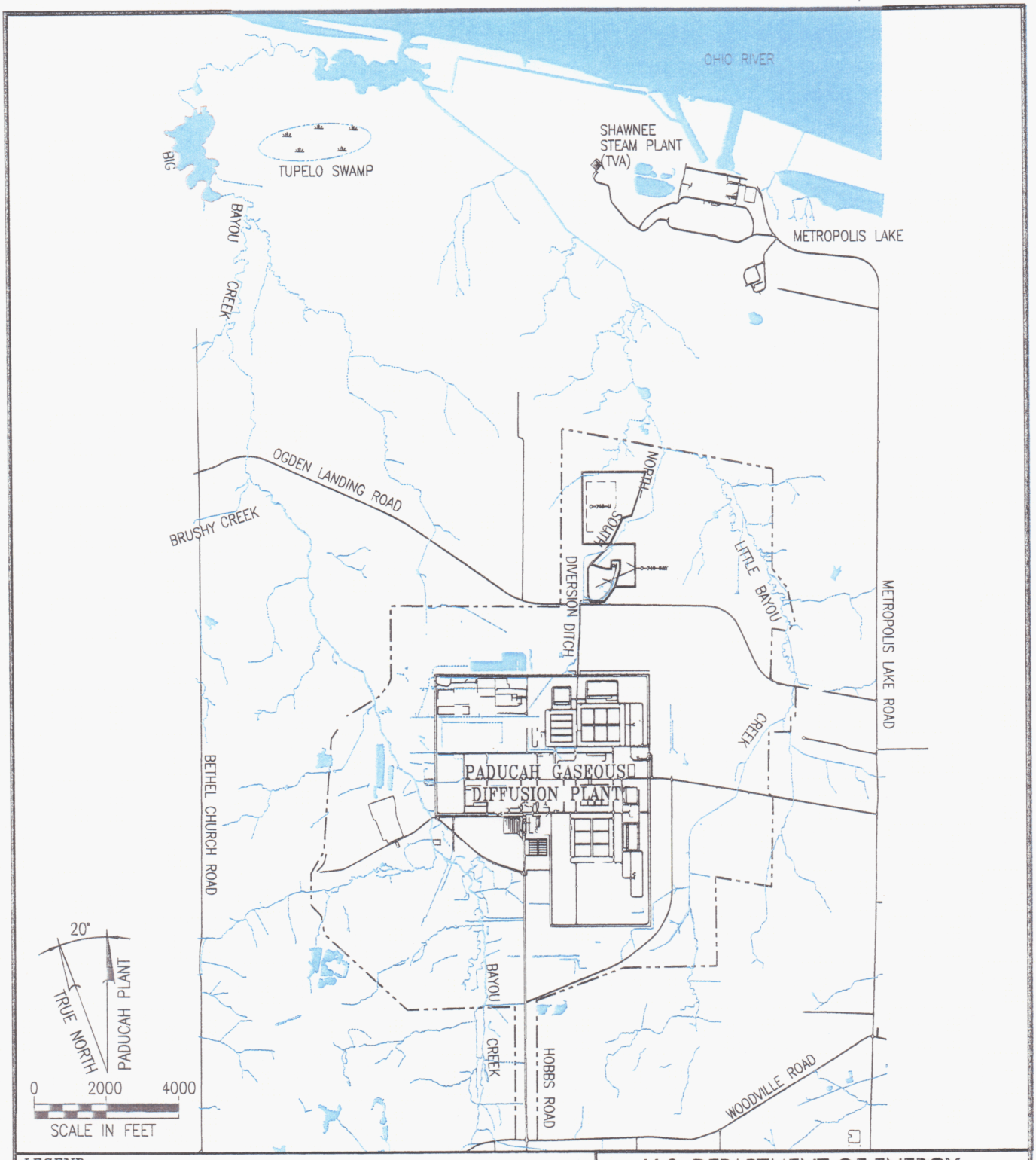
3.4.4 Eocene Sands

Eocene sands, silts, and clays overlie the Porters Creek Clay south of PGDP. Researchers have not attributed these sediments to a specific formation. The thickness of the Eocene sands approaches zero near the terrace slope and increases southward to greater than 100 ft. Eocene deposits do not underlie PGDP.

3.4.5 Continental Deposits

Pliocene and Pleistocene continental deposits unconformably overlie the Cretaceous through Eocene strata in the vicinity of PGDP. The Pliocene deposits consist of lobes of poorly sorted, silty sand and gravel that occur south of PGDP. These sediments represent an alluvial fan deposit that covered all of western Kentucky and parts of Tennessee and Illinois during the Pliocene Epoch.

Beginning under the south end of PGDP and extending north beyond the Ohio River, a thick sequence of Pleistocene continental deposits fills the buried valley of the ancestral Tennessee River. This sediment package consists of a basal sand and gravel member, the lower continental deposits, and an



LEGEND:

- SWMU LOCATION
- ASPHALT ROAD
- DOE BOUNDARY
- TERRACE
- FENCE LINE
- SURFACE WATER
- SWAMP OR MARSH

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 3.6. Surface water features in the vicinity of PGDP.

overlying finer-textured lithofacies, the upper continental deposits. Where fully developed, the upper continental deposits include a bottom sand unit overlaid by a thick silt and clay interval containing at least two horizons of sand and gravel.

Lower Continental Deposits. Pleistocene sand and gravel units, collectively averaging 30-ft thick, underlie most of PGDP and the northern portion of the Paducah Site. Depth to the top of this lower member is approximately 60 ft. The matrix is characteristically medium to coarse sand and chert gravel of variable sorting. Thickness of the individual depositional units varies widely. However, the lateral continuity of the individual depositional units typically is limited.

Upper Continental Deposits. The upper member sediments (Pleistocene) include a wide variety of textures within three depositional series.

- A basal sand unit is generally present, representing the transition from gravel and coarser sand of the lower member continental deposits to the overlying silty clay unit. The sand generally has a fining upward texture, becoming siltier toward the top of the unit.

- An overlying interval of fine-textured sediments defines a middle unit. This unit occurs everywhere, generally as a silty clay or clayey silt. However, a silty, fine sand facies is common. The thickness of the unit varies widely from <10 ft to 40 ft.

- Sand and gravel deposits define an upper unit. Texture and sorting are widely variable among the sand and gravel deposits. Where the unit is fully developed, three horizons are present: (1) a basal sand and gravel horizon; (2) a middle finer-textured horizon, typically consisting of a silty fine sand or silt; and (3) an upper sand and gravel horizon.

Other than the broad lens-character of some sand and gravel units, the upper member continental deposits do not contain recognizable bedding features. Gradational textural changes are common. Silt and clay facies typically are mottled with frequent vertical traces filled with lighter colored silt or clay.

3.4.6 Surficial Deposits/Soils

Silt of the Pleistocene Peorian Loess and an older unit tentatively identified as the Roxanna Loess covers sediments both north and south of the buried terrace slope (DOE 1997a). The loess deposit is virtually indistinguishable from silt facies of the upper member of the continental deposits. Loess typically is from 10- to 15-ft thick beneath most of PGDP; however, construction activities have excavated the loess or replaced the loess with fill material in many areas. Soils of the area are predominantly silt loams that are poorly drained, acidic, and have little organic content.

Six soil types are associated with PGDP as mapped by the Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service (USDA 1976). These are Calloway silt loam, Grenada silt loam, Loring silt loam, Falaya-Collins silt loam, Vicksburg silt loam, and Henry silt loam. The dominant soil types, the Calloway and Henry silt loams, consist of nearly level, somewhat poorly drained to poorly drained soils that formed in deposits of loess and alluvium. These soils tend to have low organic content, low buffering capacity, and acidic pH ranging from 4.5 to 5.5. The Henry and Calloway series have a fragipan horizon, a compact and brittle silty clay loam layer that extends from 26 inches below land surface to a depth of 50 inches or more. The fragipan reduces the vertical movement of water and causes a seasonally perched water table in some areas. In areas within PGDP where past construction activities have disturbed the fragipan layer, the soils are best classified as "urban."

3.5 HYDROLOGY

PGDP is located in an area of abundant surface water and groundwater resources. Creeks that bound the east and west sides of PGDP flow north from PGDP to join with the Ohio River. The sand and gravel deposit that forms the shallow aquifer beneath most of PGDP and the contiguous area to the north begins at the Porters Creek Clay Terrace under the south end of PGDP and extends to the north beyond the Ohio River.

3.5.1 Surface Water Hydrology

PGDP is located in the western portion of the Ohio River basin. The plant is within the drainage areas of Bayou and Little Bayou creeks and is situated on the divide between the two creeks, with Bayou Creek on the west and Little Bayou Creek on the east (Fig. 3.6). Surface water bodies in the vicinity of PGDP include the Ohio River to the north, Metropolis Lake (located east of Shawnee Steam Plant), Bayou Creek, Little Bayou Creek, and numerous small tributaries and creeks, as well as surface-water ditches and lagoons located within the plant boundary. There is a marshy area, called the Tupelo Swamp, just south of the confluence of Bayou and Little Bayou creeks. The smaller surface water bodies are expected to have only localized effects on the regional groundwater flow pattern.

Bayou Creek is a perennial stream with a drainage area of approximately 18.6 $mile^2$ that flows generally northward from approximately 2.5 miles south of the plant to the Ohio River. Little Bayou Creek, which becomes a perennial stream north of PGDP due to plant discharges, originates within the WKWMA and flows northward to the Ohio River. The approximate drainage area of Little Bayou Creek is 8.5 $mile^2$ (CH2M HILL 1992). The confluence of the two creeks is approximately 3 miles north of the plant site (as measured over land), just upstream of the location at which the creeks discharge into the Ohio River. The drainage areas for both creeks generally are rural; however, they receive surface drainage from numerous swales that drain residential and commercial properties, including the WKWMA, PGDP, and TVA Shawnee Steam Plant. Additionally, the channel of Little Bayou Creek was modified near TVA to accommodate industrial land use. A major portion of the flow in both creeks north of PGDP is effluent water from the plant, discharged through Kentucky Pollutant Discharge Elimination System (KPDES)-permitted outfalls.

The U.S. Geological Survey (USGS) maintains gauging stations on Bayou Creek, 4.1 and 7.3 river miles from the Ohio River, and a station on Little Bayou Creek, 2.2 river miles upstream from its confluence with Bayou Creek. The mean monthly discharge at Bayou Creek varies from 6.5 to 60.7 ft^3/s. The mean monthly discharge on Little Bayou Creek ranges from 0.89 to 33.5 ft^3/s. Two studies have investigated the dynamics of interaction between surface water and groundwater in Bayou and Little Bayou creeks. The USGS performed a seepage survey in Bayou and Little Bayou creeks on August 15 and 16, 1989 (Evaldi and McClain 1989). Mr. Eric Wallin monitored indicators of seepage between the creeks and groundwater during the period July 22, 1996, through October 12, 1997, as the subject for a Master of Science thesis at the University of Kentucky (Fryar and Wallin 1998).

The 1989 survey determined a point on both Bayou and Little Bayou creeks where the creeks changed from losing streams (Bayou Creek), or streams of no groundwater interaction (Little Bayou Creek), to gaining streams. On Bayou Creek, the gaining reach began approximately 3.5 river miles upstream from the Ohio River. On Little Bayou Creek, the point where the creek became a gaining stream was located approximately 2.6 river miles upstream from the Ohio River. The USGS researchers noted channel-bank seeps along the lower reaches of both creeks.

The July 1996 through October 1997 study assessed both spatial and temporal trends in stream-to-groundwater interaction along the creeks. This study assessed Bayou Creek from south of PGDP to the

Ohio River and Little Bayou Creek from the plant outfalls to the river. The investigation found that the magnitude of seepage varied with season but concurred with the 1989 survey location of the inflection point on Little Bayou Creek where the stream begins to gain. The later study found that gaining reaches on Bayou Creek are limited to the area south of PGDP and very near the Ohio River.

Man-made drainages receive stormwater and effluent from PGDP. The plant monitors 17 outfalls, which have a combined average daily flow of approximately 4.9 million gallons per day (LMES 1992b). Water flow in some of these ditches is intermittent based on seasonal rainfall. The plant ditches generally are considered to be located in areas where the local groundwater table is below the bottoms of the ditch channels; therefore, the ditches probably function as influent (losing) streams most of the time, resulting in some discharge to the subsurface.

3.5.2 Groundwater Hydrology

The Jackson Purchase Region is characterized by a thick sequence of unconsolidated Cretaceous through Holocene period sediments deposited on an erosionally truncated Paleozoic surface. The flow system in the vicinity of PGDP exists primarily within unconsolidated sediments.

The regional groundwater flow systems occur within the Mississippian bedrock, Cretaceous McNairy Formation, Eocene sands, Pliocene terrace gravel, Pleistocene lower continental deposits, and upper continental deposits. Terms used to describe the hydrogeologic flow system are the Bedrock Aquifer, McNairy Flow System, Eocene Sands and Terrace Gravel, the Regional Gravel Aquifer (RGA), and the Upper Continental Recharge System (UCRS). Specific components for the regional groundwater flow system, shown in Fig. 3.7, have been identified and are defined in the following subsections.

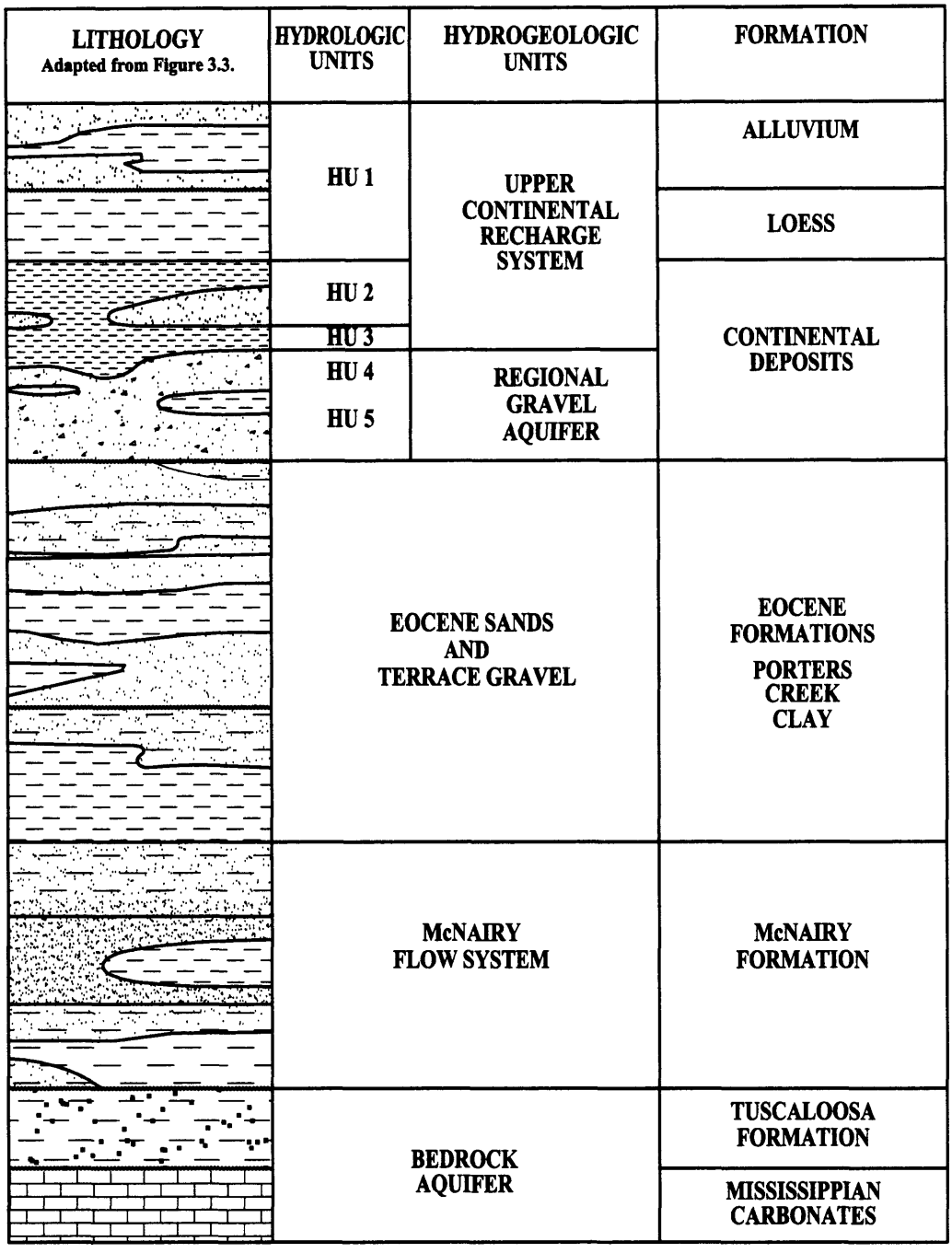
Bedrock Aquifer

Limestone, which is believed to be Mississippian-age Warsaw Limestone, subcrops beneath PGDP. Groundwater production from the bedrock aquifers comes from fissures and fractures and from the weathered rubble zone near the top of the bedrock. The bottom of a rubble zone developed in the top of the Mississippian carbonate bedrock generally marks the base of the active groundwater flow system beneath PGDP.

McNairy Flow System

This component, formerly termed the "deep groundwater system," consists of the interbedded and interlensing sand, silt, and clay of the Cretaceous McNairy Formation. The sand in the McNairy Formation is an excellent aquifer in the southeastern part of the Jackson Purchase Region; however, near PGDP, the McNairy Formation contains significant amounts of silt and clay (LMES 1992a). Reported hydraulic conductivities for the McNairy Flow System range from 1.4E-8 to 4.7E-2 cm/s (DOE 1996b) Regionally, the McNairy Formation recharges along areas of outcrop in the eastern part of the region, near Kentucky Lake and Lake Barkley (USGS 1973). Water movement is north and northwest toward discharge areas in Missouri and along the Ohio River.

The McNairy Formation subcrops beneath the plant at depths ranging from approximately 100 to 350 ft. Overall, sand facies account for 40 to 50% of the total formation thickness of approximately 225 ft. The upper and middle McNairy members in the area of PGDP are predominantly silty and clayey fine sands. Site data indicate the middle McNairy member, also known as the Levings member, to have limited downward movement of contamination. However, where the RGA is in direct hydraulic connection with coarser-grained sediments of the McNairy Formation, the McNairy flow is coincident with that of the RGA.



HU = HYDROLOGIC UNIT

Not To Scale

Fig. 3.7. Hydrogeologic units beneath PGDP.

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-980R22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Terrace Gravel and Eocene Sands

Pliocene-age gravel deposits and Eocene sands overlie the Paleocene Porters Creek Clay in the southern portion of the Paducah Site. A water table flow system developed in these units provides some throughflow to the north, across the Porters Creek Clay Terrace, ultimately recharging the RGA (Fig. 3.8). Most of this throughflow is realized east of PGDP, where the Pliocene Terrace Gravel is thickest adjacent to the Porters Creek Clay Terrace. The water table flow systems, immediately south and west of PGDP, generally discharge to Bayou Creek because of the shallow depth of the Porters Creek Clay in those areas. Depth to water within the terrace gravel just south of PGDP, but on the Paducah Site, ranges from approximately 33.63 ft to 35.92 ft for the time period 1990 through 2000. Reported hydraulic conductivities for these flow systems range from 1E-6 to 1.4E-3 cm/s (DOE 1996b).

Regional Gravel Aquifer

The RGA consists primarily of the coarse sand and gravel facies of the lower continental deposits. Permeable sands of the upper continental deposits and the McNairy Formation, where they occur adjacent to the lower continental deposits, are included in the RGA. The RGA is found throughout the plant area and to the north, but pinches out to the south, southeast, and southwest along the slope of the Porters Creek Clay terrace. Regionally, the RGA includes the Holocene-aged alluvium found adjacent to the Ohio River.

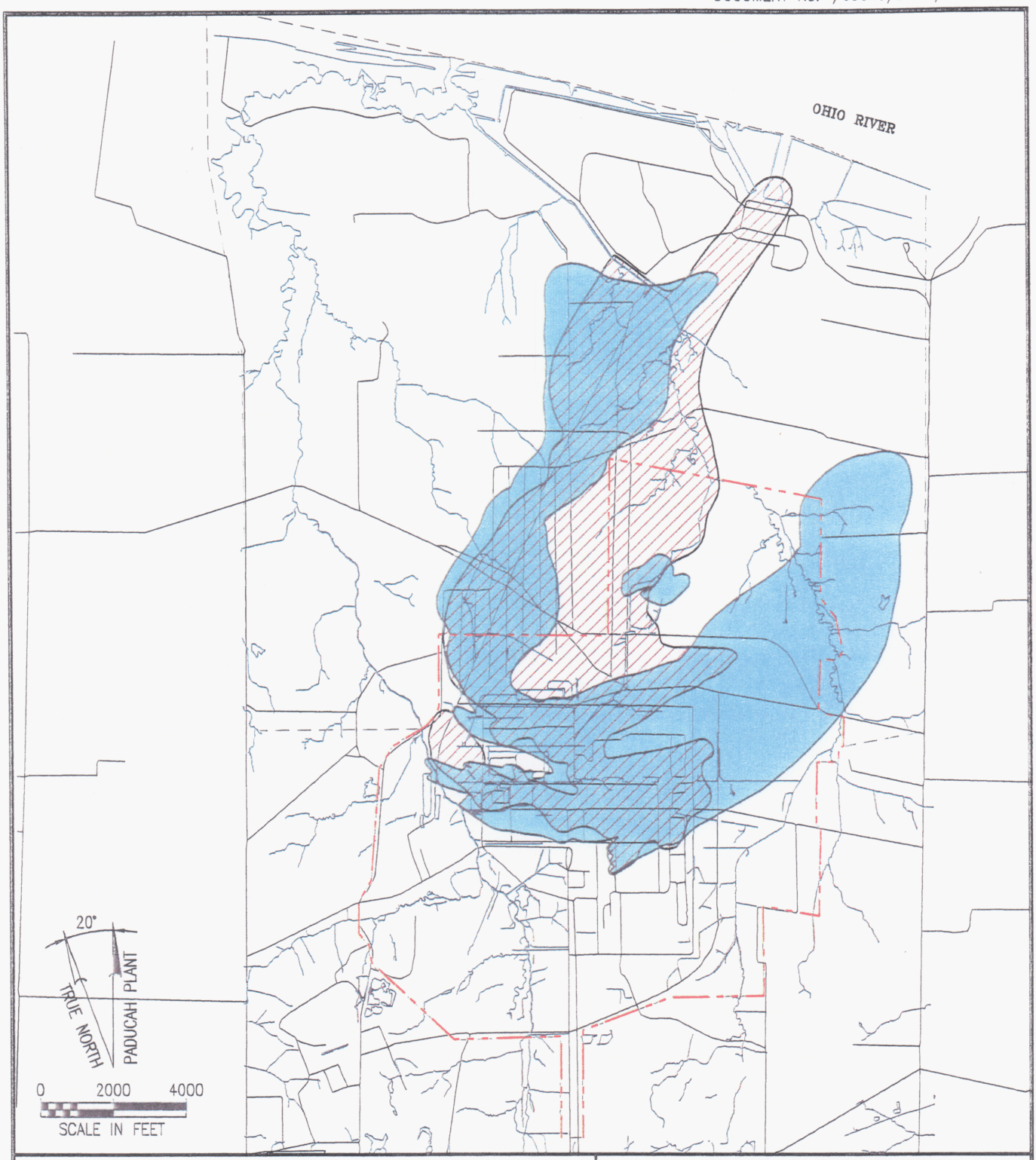
The RGA is the shallowest aquifer beneath PGDP and is the dominant groundwater flow system in the area extending from PGDP to the Ohio River. Regional groundwater flow within the RGA trends north–northeast toward a base level represented by the Ohio River (Fig. 3.8). East–west heterogeneities within the lower continental deposits and leaks from PGDP utilities cause groundwater flow to be directed locally to the northeast and northwest of the plant. Differences in permeability and aquifer thickness also affect the hydraulic gradient. The lowest gradients, in the north–central portion of the plant site, are the result of a thick section of the RGA containing higher fractions of coarse sand and gravel. Northward, near the Ohio River, the hydraulic gradient increases as a result either of a thinner section of RGA or of low-permeability bottom sediments in the Ohio River. The hydraulic gradient varies spatially but is on the order of 1×10^{-4} to 1×10^{-3} m/m. Hydraulic conductivities from the RGA have been reported as ranging from 10^{-4} to 1 cm/s (DOE 1997b). The RGA is the dominant pathway by which groundwater contamination migrates off-site. Figure 3.8 displays the most recent mapping of trichloroethene and ^{99}Tc plumes in the RGA.

Upper Continental Recharge System

The UCRS consists of a thick, surface loess unit and the upper continental deposits. Hydrogeologists at PGDP have differentiated the UCRS into three general horizons, or hydrologic units (HUs), which are as follows:

HU 1—an upper silt and clay interval (the surface loess unit),
HU 2—an intervening interval of common sand and gravel lenses, and
HU 3—a lower silt and clay interval.

Groundwater flow in the UCRS is predominantly downward into the RGA, hence the term "recharge system." Vertical hydraulic gradients generally range from 0.5 to 1 m/m where measured by wells completed at different depths in the UCRS. The presence of steep but undetermined vertical gradients for most areas of PGDP has limited the ability to map a water table at PGDP. However, the available UCRS well network is sufficient to determine the main features of the water table. In general, the water



U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-98OR227000
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 3.8. Tc-99 and TCE plume migration.

table is less than 20 ft deep in the western half and south quadrant of PGDP. Depth to water is as much as 40 ft in a broad trough in the water table in the northeast and central areas of PGDP (Fig. 3.9).

Regionally, the thickness of the saturated UCRS ranges from 0 to 50 ft. Measurements of UCRS hydraulic conductivity ranged from 1.7×10^{-8} to 3.2 cm/s (DOE 1998). The range of eight orders of magnitude reflects the varied textures of the UCRS matrix.

3.6 TECTONICS

3.6.1 Tectonic Location

Portions of three major structural provinces occur in the vicinity of PGDP. PGDP overlies the northern end of the Mississippi Embayment, an extension of the Gulf Coastal Plain just south of its boundary with the Illinois Basin, a "typical" interior basin (Leighton et al. 1991) (Fig. 3.10). These two provinces are bounded to the west in the vicinity of PGDP by the Ozark dome, a persistent positive area throughout the Paleozoic era (225 million to 570 million years ago).

Several large-scale fault systems in Paleozoic and older rocks have controlled much of the region's geologic history (Nelson 1998). The Ste. Genevieve fault zone separates the Ozark dome from the Illinois Basin. Arching west and north of PGDP is a dogleg-shaped, Cambrian-failed rift composed of two segments, the northeast-trending Reelfoot rift of the Mississippi Embayment and the east-trending Rough Creek graben of the Illinois Basin.

3.6.2 Seismic Setting

Much of the seismic hazard of the PGDP area is attributed to the New Madrid Seismic Zone (NMSZ). The focus of the NMSZ occurs to the southwest of PGDP within the Reelfoot rift. The International Building Code seismic hazard zone map shows PGDP to be located on or near the margin between a Seismic Hazard Zone of 3 and 2A (ICBO 1988).

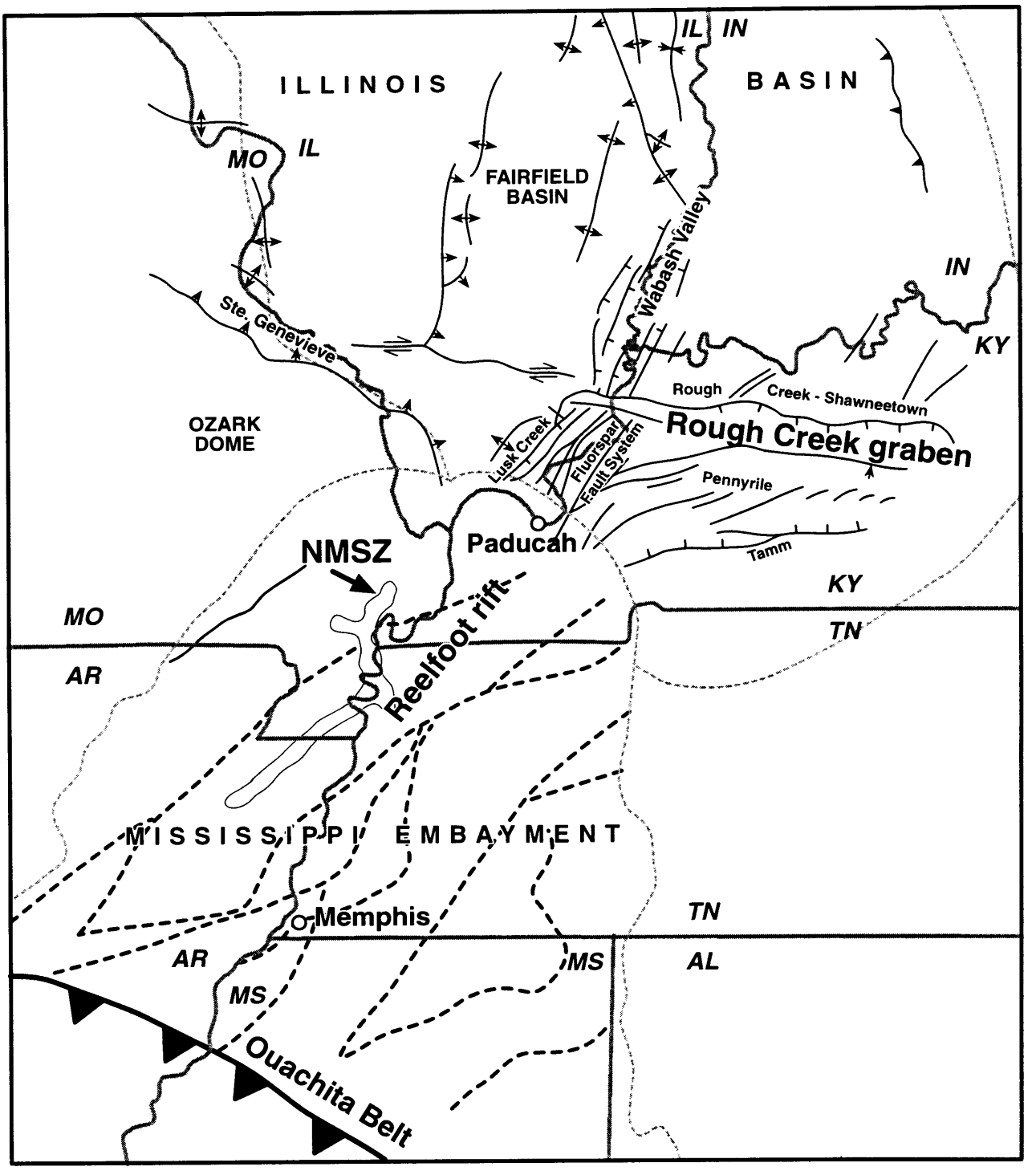
Site-specific soil modeling indicates that PGDP has low potential to be impacted by liquefaction and soil settlement in the event of an earthquake (Sykora and Davis 1993). The location of PGDP on an upland surface above the alluvial valley of the Ohio River is the foremost factor that contributes to the low potential for liquefaction. Chapter 3 of the *Seismic Issues for Consideration in Site Selection and Design of a Potential On-Site Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Waste Disposal Facility at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (DOE 2000b), summarizes the regulatory considerations related to seismic design criteria relative to PGDP.

3.6.3 Faults and Lineaments

The Reelfoot rift system subsided rapidly throughout Paleozoic time (225 million to 570 million years ago) (Nelson 1998), serving as a center of sedimentation for the Illinois Basin (Klein and Hsui 1987; Kolata and Nelson 1991a, 1991b). Boundary faults were reactivated periodically. Post-Pennsylvanian displacements along the Rough Creek-Shawneetown fault system split the Illinois Basin into two unequal parts: a broad, but shallow, basin to the north and a narrow, but deep, basin to the south. Beginning in Cretaceous time (65 million to 136 million years ago), the Reelfoot rift area again subsided, forming the Mississippi Embayment. Consequently, northeast-trending faults were rejuvenated in and

THIS PAGE UNAVAILABLE
FOR
PUBLIC RELEASE

IF YOU WISH TO VIEW,
PLEASE CALL
BECHTEL JACOBS SECURITY
(PHONE: 441-5037)



LEGEND

Illinois Basin faults

Mississippi Valley graben faults

NMSZ = New Madrid Seismic Zone

0 50 mi

0 50 km

N

Fig. 3.10. Regional tectonic map.

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS
Bechtel Jacobs Company LLC

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

SAIC

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

near the NMSZ. Within southern Illinois and western Kentucky, the Lusk Creek fault zone and Rough Creek-Shawneetown fault system mark the northwestern and northern margins of the failed rift complex, while the Tabb and Pennyrile fault systems mark part of the southeastern and southern margins (Fig. 3.11).

Recent mapping of the Flourspar fault system in southern Illinois provides convincing evidence of widespread tectonic faulting of Cretaceous and younger units. The style and trend of these faults are mostly consistent with the contemporary stress regime and with the inferred style and trend of active faults in the New Madrid area (Fig. 3.11) (Nelson 1998). Traces of several area faults in southern Illinois trend toward PGDP.

The Barnes Creek fault zone, if extended below the Mississippi Embayment, would be the most likely fault to pass through or near PGDP (on the east side). Where exposed in southern Illinois, the Barnes Creek fault zone is a single fault or a zone of sub-parallel faulting less than 0.25 mile wide. The vertical separation along the fault typically is less than 100 ft. Nelson et al. (1996) characterize the latest displacement along the fault zone probably as early Pleistocene (pre-13,000 to 14,000 years). All spays of the fault are overlain by undeformed Holocene gravels and silts.

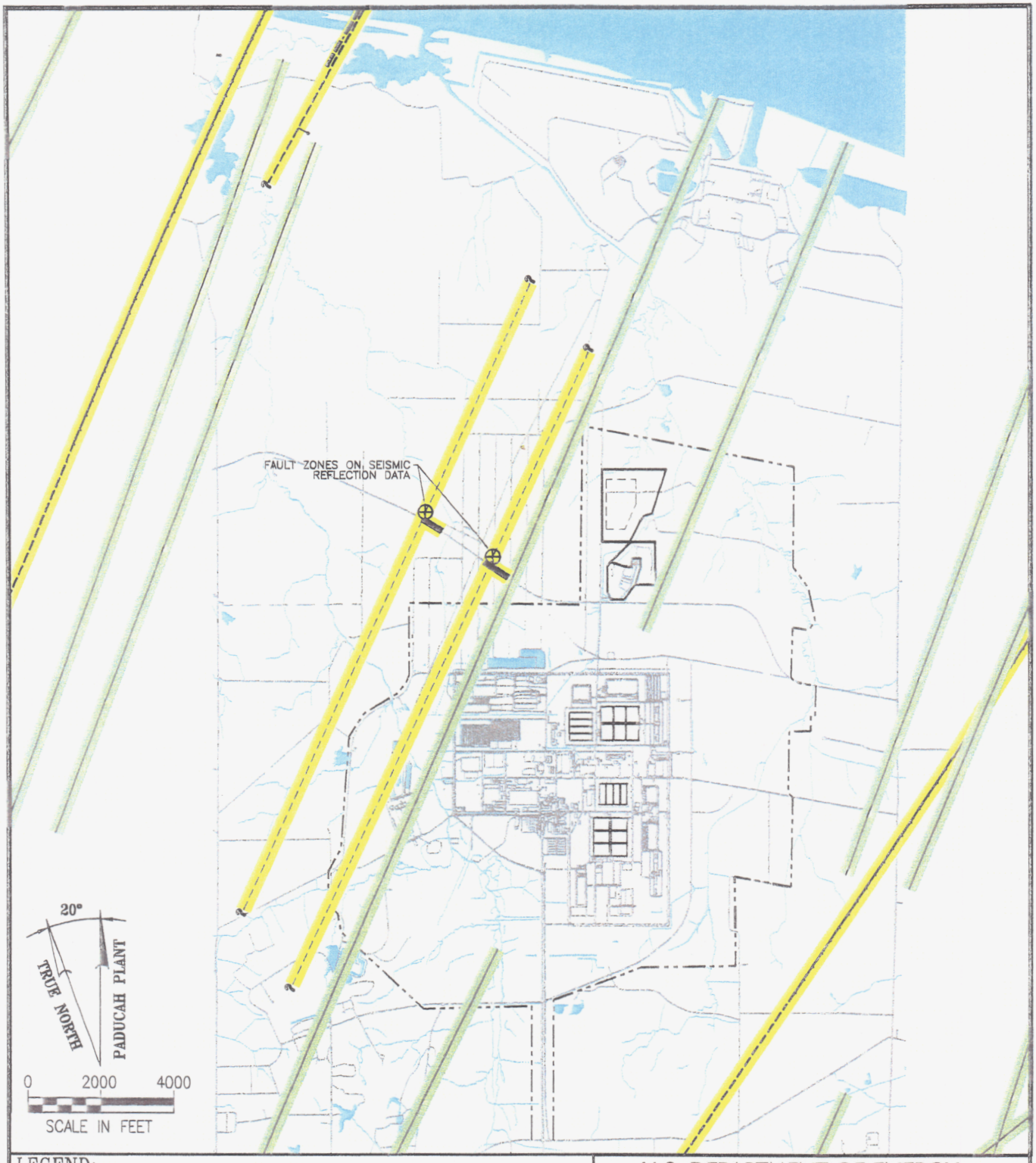
The other likely fault zone to pass below or near PGDP (probably on the west side) is the Massac Creek structure of the Hobbs Creek fault zone. Nelson et al. (1996) interpret this graben in the Hobbs Creek fault zone to have formed in Miocene to early Pleistocene time.

Drahovzal and Hendricks (1996), in a Kentucky Geological Survey Open-File Report, documented the presence of several lineaments at PGDP that parallel fault trends evident in southern Illinois. They postulate that faults of southern Illinois extend for some distance southwestward beneath the Cretaceous and younger sediments that fill the Mississippi Embayment (i.e., into McCracken and adjacent counties in Kentucky) based upon (1) studies by others (i.e., Nelson 1995, Nelson et al. 1996, and Keifer et al. 1996) that confirm faulting in the Quaternary and Tertiary sediments of Illinois; (2) interpretations that the faulting continues downward to at least the Precambrian basement; (3) the presence of northeast-trending faults in the plant area; and (4) the number of earthquake epicenters recognized in the area. Figure 3.11 illustrates these lineaments.

In addition to the lineaments shown, seismic reflection data suggest the presence of other faults at PGDP that offset the bedrock and the RGA (Street and Langston 1998). Therefore, all potential areas on DOE property are considered essentially equivalent with respect to the possible existence of lineaments or faults.

3.6.4 Other Potential Tectonic Features

The most intense recent geological research has focused on the northwestern margin of the Mississippi Embayment in Missouri and Arkansas and surficial geologic features coincident with the 250-mile-long Arkansas–Illinois geophysical lineament (Harrison and Schultz 1994; Hildenbrand and Hendricks 1995). This lineament extends from northeastern Arkansas to the northeast, trending approximately midway between Sikeston, Missouri, and Cape Girardeau, Missouri, and into Illinois. The lineament passes within approximately 25 miles of PGDP. At least 12 earthquakes of magnitude 3 and greater have occurred in the last few decades that reasonably can be attributed to the lineament (Harrison and Schultz 1994). Investigation along the lineament has found Quaternary faulting, some of which has occurred within the last 12,000 years (Hoffman et al. 1996a, 1996b; Palmer et al. 1996). However, on-trend physiographic features that might be associated with the geophysical lineament are lacking in southern Illinois in spite of thorough geologic mapping (Nelson et al. 1996).



LEGEND:

- DOE BOUNDARY
- LINEAMENT FEATURE FROM DRAHOVZAL & HENDRICKS (1996)
- POTENTIAL FAULT AS DEFINED BY STREET & LANGSTONE (1998)
- 200' OFFSET (FAULTS)
- 200' OFFSET (LINEAMENTS)

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-98OR227000
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 3.11. Postulated faults and lineaments (pre-Holocene) in the PGDP vicinity.

3.7 ECOLOGICAL RESOURCES

PGDP and surrounding DOE-owned property are located in the Interior Low Plateau, Shawnee Hills Section of the Eastern Broadleaf Forest (Continental) Province of the Hot Continental Division of the Humid Temperate Domain (Bailey 1994). The vegetation types typical of this ecoregion are oak-hickory forests in the uplands and oak-gum-cypress forests in the bottomlands. The floodplain of the Ohio River in this area is dominated by sycamore, Kentucky coffeetree, sugar berry, and honey locust with local tupelo and cypress swamp communities. Due to anthropogenic disturbances, the landscape is now a mosaic of primarily forest and agricultural lands. The ecological resources (terrestrial and aquatic flora and fauna, wetlands, and T&E species) in the PGDP vicinity are detailed below.

3.7.1 Terrestrial Systems

The upland habitats in the PGDP area support a variety of plant and wildlife species. Because much of the Paducah Site and WKWMA terrestrial habitat is managed for multiple uses, the diversity of habitat is excellent. Forest and shrub tracts alternate with fencerows and transitional edge habitats (ecotones) along roads and transmission-line corridors. Fencerow communities are dominated by elm, locust, oak, and maple, with an often thick understory of sumac, honeysuckle, blackberry, and grape. Herbaceous growth in these areas includes clover, plantain, and numerous grasses. The numerous ditches, upland embankments along streams, and open areas around ponds in the area also provide diversity of habitat for wildlife (CH2M HILL 1991a).

Vegetation

The terrestrial community is described by the dominant vegetation sites that characterize the community. The communities range from oak-hickory forest in areas that have been relatively undisturbed to managed fencerows and agricultural lands. Detailed investigations of vegetation have been conducted for Ballard and McCracken counties in Kentucky by the WKWMA and the COE. Significant areas of the Paducah Site and WKWMA include vegetation managed for consumption by wildlife, especially deer. In addition, 26% of the total land area of Ballard County and 24% of McCracken County are designated as commercial forestland.

Most of the area in the vicinity of PGDP has been cleared of vegetation at some time, and much of the grassland habitat is mowed regularly by PGDP personnel. Approximately 2000 acres in the WKWMA consist of old field grasslands. Approximately 800 acres within the WKWMA are in scrub or shrub habitat. The WKWMA performs controlled burning, provides food plantings for wildlife, or otherwise manages about 500 acres per year.

Wildlife

Wildlife commonly found in the PGDP area consists of species indigenous to open grassland, thickets, and forest habitats. Observations by ecologists and WKWMA staff have provided a qualitative description of wildlife communities likely to inhabit the vegetation communities in the vicinity of PGDP. Open herbaceous areas are frequented by rabbits, mice, and a variety of other small mammals. Birds include red-winged blackbirds, quail, sparrows, and predators such as hawks and owls. In ecotones (including fencerows, low shrub, and young forests), a variety of wildlife is present, including opossum, vole, mole, raccoon, and deer. Birds typical in the ecotones include red-winged blackbird, loggerhead, shrike, mourning dove, bobwhite, quail, wild turkey, northern cardinal, and eastern meadowlark. Several groups of coyotes also reside in the vicinity of PGDP. In mature forests, squirrel, various songbirds, and great horned owls may be present. The primary game species hunted for food in the area are deer, turkey, opossum, rabbit, raccoon, and squirrel. Much of the area is attractive to game and nongame species

because of the intense management program for game that has been implemented in the WKWMA (CH2M HILL 1991a).

3.7.2 Aquatic Systems

Both Bayou and Little Bayou creeks and tributaries support a variety of aquatic life, including several species of sunfish, spotted and largemouth bass, bullheads, and creek chub. Inhabitants of shallow streams, characteristic of the two main area creeks, are predominantly bluegill, green and longear sunfish, and stonerollers.

In addition to stream habitats, about 13 fishing ponds are located primarily in the WKWMA. Most of these ponds north of PGDP are used for public fishing. Ponds in the former KOW area have been posted with consumption warnings because of contamination from the former KOW operations. Pond areas generally are dominated by largemouth bass, bluegill, and, to a lesser extent, green sunfish. Prior to 1990, Little Bayou Creek also was fished; however, due to the detection of elevated concentrations of PCBs in fish taken from Little Bayou Creek, consumption warnings have been posted.

Aquatic habitats are used by muskrat and beaver. Many species of water birds, including wood duck, geese, heron, and species of migratory birds, also use these areas. Numerous other smaller ponds and abandoned gravel pits usually contain water and may have functioning ecosystems.

3.7.3 Wetlands

Habitats that have soil and hydrology capable of supporting vegetation adapted for hydric environments are considered wetlands. These habitats include marshes (wetlands dominated by herbaceous species) and swamps (wetlands dominated by woody species), as well as many other ecotones between terrestrial and aquatic habitats. Near PGDP, there are numerous areas where these conditions prevail, particularly in the region adjacent to the Ohio River. Within the WKWMA, approximately 4000 acres have been identified as having hydric soil capable of supporting wetlands. Some of these systems include a special-status species, the water hickory. Approximately 400 acres of this area are Tupelo Swamp, and another 600 acres are bottomland hardwood. The Tupelo Swamp, which is located approximately 2 miles north of the site, is considered very unusual by state and federal land managers and is thought to be only one of three similar systems left in the United States. Most of the remainder of the wetlands in the PGDP vicinity is in agricultural use or is in some stage of succession to wetland scrub. Other wetland habitats are found associated with the shorelines of ditches and creeks (riparian vegetation), although many of these are incised and have only marginal areas of wetlands. Most ponds also include shallow wetland systems along their shorelines and along contiguities with bottomland hardwood systems (CH2M HILL 1991a).

The 1994 COE environmental investigations identified 11,728 acres of wetlands surrounding PGDP (Fig. 3.12). This investigation identified and grouped wetlands into vegetation cover types encompassing forested, scrub/shrub, and emergent wetlands (COE 1994). Wetlands inside the plant security fence are confined to portions of drainage ditches traversing the site (CDM Federal 1994). Functions and values of these areas inside the plant as wetlands are low to moderate with regard to groundwater recharge, floodwater retention, and sediment/toxicant retention (Jacobs 1995). Other functions and values such as wildlife habitat/benefits are low.

Flooding is associated with the Ohio River, Bayou Creek, and Little Bayou Creek. The majority of overland flooding is associated with the Ohio River floodplain. Bayou and Little Bayou Creek flooding is generally confined to the areas within and immediately adjacent to the channels of these streams. A floodplain analysis performed by the COE in 1994 found that much of the built-up portions of the plant lie outside the 100- and 500-year floodplains of these streams, as shown on Fig. 3.12 (COE 1994).

because of the intense management program for game that has been implemented in the WKWMA (CH2M HILL 1991a).

3.7.2 Aquatic Systems

Both Bayou and Little Bayou creeks and tributaries support a variety of aquatic life, including several species of sunfish, spotted and largemouth bass, bullheads, and creek chub. Inhabitants of shallow streams, characteristic of the two main area creeks, are predominantly bluegill, green and longear sunfish, and stonerollers.

In addition to stream habitats, about 13 fishing ponds are located primarily in the WKWMA. Most of these ponds north of PGDP are used for public fishing. Ponds in the former KOW area have been posted with consumption warnings because of contamination from the former KOW operations. Pond areas generally are dominated by largemouth bass, bluegill, and, to a lesser extent, green sunfish. Prior to 1990, Little Bayou Creek also was fished; however, due to the detection of elevated concentrations of PCBs in fish taken from Little Bayou Creek, consumption warnings have been posted.

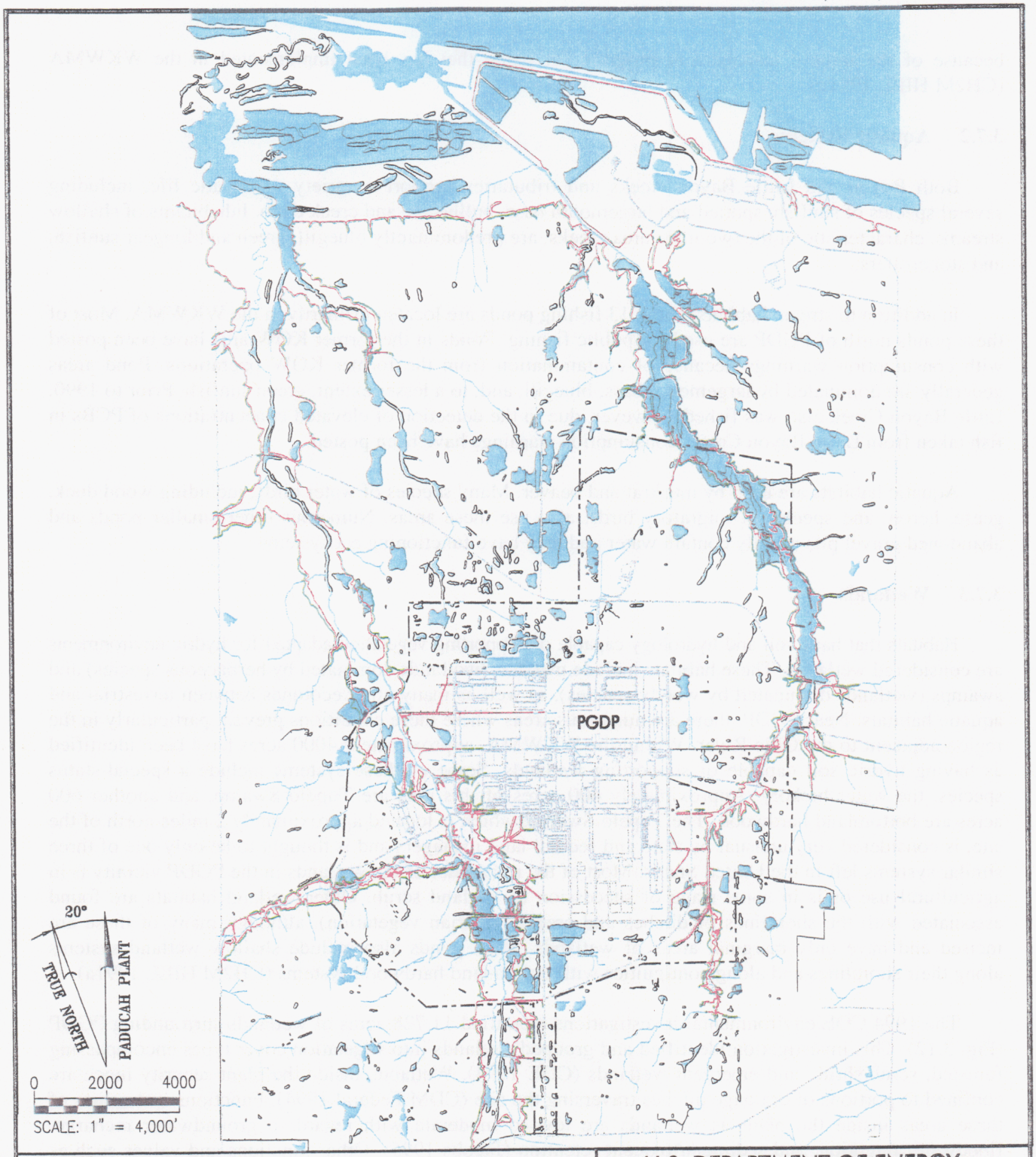
Aquatic habitats are used by muskrat and beaver. Many species of water birds, including wood duck, geese, heron, and species of migratory birds, also use these areas. Numerous other smaller ponds and abandoned gravel pits usually contain water and may have functioning ecosystems.

3.7.3 Wetlands

Habitats that have soil and hydrology capable of supporting vegetation adapted for hydric environments are considered wetlands. These habitats include marshes (wetlands dominated by herbaceous species) and swamps (wetlands dominated by woody species), as well as many other ecotones between terrestrial and aquatic habitats. Near PGDP, there are numerous areas where these conditions prevail, particularly in the region adjacent to the Ohio River. Within the WKWMA, approximately 4000 acres have been identified as having hydric soil capable of supporting wetlands. Some of these systems include a special-status species, the water hickory. Approximately 400 acres of this area are Tupelo Swamp, and another 600 acres are bottomland hardwood. The Tupelo Swamp, which is located approximately 2 miles north of the site, is considered very unusual by state and federal land managers and is thought to be only one of three similar systems left in the United States. Most of the remainder of the wetlands in the PGDP vicinity is in agricultural use or is in some stage of succession to wetland scrub. Other wetland habitats are found associated with the shorelines of ditches and creeks (riparian vegetation), although many of these are incised and have only marginal areas of wetlands. Most ponds also include shallow wetland systems along their shorelines and along contiguities with bottomland hardwood systems (CH2M HILL 1991a).

The 1994 COE environmental investigations identified 11,728 acres of wetlands surrounding PGDP (Fig. 3.12). This investigation identified and grouped wetlands into vegetation cover types encompassing forested, scrub/shrub, and emergent wetlands (COE 1994). Wetlands inside the plant security fence are confined to portions of drainage ditches traversing the site (CDM Federal 1994). Functions and values of these areas inside the plant as wetlands are low to moderate with regard to groundwater recharge, floodwater retention, and sediment/toxicant retention (Jacobs 1995). Other functions and values such as wildlife habitat/benefits are low.

Flooding is associated with the Ohio River, Bayou Creek, and Little Bayou Creek. The majority of overland flooding is associated with the Ohio River floodplain. Bayou and Little Bayou Creek flooding is generally confined to the areas within and immediately adjacent to the channels of these streams. A floodplain analysis performed by the COE in 1994 found that much of the built-up portions of the plant lie outside the 100- and 500-year floodplains of these streams, as shown on Fig. 3.12 (COE 1994).



LEGEND:

- DOE BOUNDARY
- 100-YEAR FLOODPLAIN
- 500-YEAR FLOODPLAIN
- DELINEATED WETLANDS

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 3.12. Wetlands and floodplains in the vicinity of PGDP.

3.7.4 Threatened and Endangered Species

Potential habitat for federally listed T&E species was evaluated for the area surrounding PGDP during the 1994 COE environmental investigation of PGDP and inside the fence of PGDP during the 1994 investigation of sensitive resources at PGDP (COE 1994; CDM Federal 1994). No T&E species or potential habitat for any T&E species were observed during the inside-the-fence investigation. In 1999, five Indiana bats were captured near the lower downstream reaches of Bayou Creek (KDFWR 2000).

Ten federally listed, proposed, or candidate species have been identified as potentially occurring at or near PGDP (Table 3.1). None of the species has been reported as sighted on the Paducah Site. Potential summer habitat (shown in Fig. 3.13) exists there for the Indiana bat, and it has been captured in the vicinity. No critical habitat for any of these species has been designated anywhere in the study area (BJC 2000a).

Table 3.1. Federally listed, proposed, and candidate species potentially occurring within PGDP area

Common name	Scientific name	Endangered Species Act status
Indiana Bat	*Myotis sodalis*	Listed Endangered
Interior Least Tern	*Sterna antillarum athalassos*	Listed Endangered
Pink Mucket	*Lampsilis abrupta*	Listed Endangered
Ring Pink	*Obovaria retusa*	Listed Endangered
Orange-footed Pearly Mussel	*Plethobasus cooperianus*	Listed Endangered
Fat Pocketbook	*Potamilus capax*	Listed Endangered
Tubercled-blossom Pearly Mussel	*Epioblasma torulosa torulosa*	Listed Endangered
Bald Eagle	*Haliaeetus leucocephalus*	Listed Threatened
Sturgeon Chub	*Macrhybopsis gelida*	Candidate
Sicklefin Chub	*Macrhybopsis meeki*	Candidate

3.8 RADIATION ENVIRONMENT

In 1998, DOE conducted continuous monitoring for direct external radiation exposure. The monitoring results indicate that, due to inaccessibility of radioactive source areas, the dose to the maximally exposed individual member of the public (i.e., the neighbor living closest to the PGDP security fence) from DOE operations did not vary statistically from background (BJC 2000a).

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER
US GOVERNMENT CONTRACT DE-AC-05-98OR227000
Oak Ridge, Tennessee • Paducah, Kentucky • Portsmouth, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 3.13. Potential summer habitat for the Indiana bat in the PGDP area.

4. IDENTIFICATION OF CANDIDATE SITES

4.1 INTRODUCTION

Potential candidate sites were identified after considering the universe of possible sites over the whole area within DOE-owned property. In doing so, only ten candidate sites were identified that were considered suitable. To be suitable, a site must meet the following conditions:

- contain at least 110 acres in contiguous property;
- be located entirely on DOE-owned property;
- not interfere with existing PGDP plant operations or operating facilities;
- not cross over major roads, railroads, or creeks;
- ensure that long-term performance objectives can be met; and
- be cost-effective; namely, development of the site must not be technically impractical or cost-prohibitive.

Candidate site identification consisted of defining all locations within the DOE-owned property boundary that could reasonably be considered for facility development. To facilitate this effort, a preliminary site review (PSR) was conducted to identify candidate sites for the potential waste disposal facility. The PSR involved obtaining a base map of the DOE-owned property and reviewing it with personnel knowledgeable of PGDP site conditions to identify areas known or suspected to be unsuitable. The primary emphasis in disposal site suitability is whether the disposal site features ensure that the long-term performance objectives (isolation of wastes to limit exposure to humans) are met.

During the PSR areas were considered unsuitable sites if they (1) potentially compromised long-term objectives, (2) were considered technically impractical, or (3) were too cost prohibitive to mitigate using engineering controls. As such, during the PSR several areas were not considered suitable sites for locating a waste disposal facility. For the purpose of this discussion, technical impracticability was defined in terms of potentially exceeding reasonable design cost and technological limitations to obtain minimal benefits. For example, trying to reroute Bayou Creek to locate a site in the south-central portion of the site would be considered technically impractical and cost prohibitive.

Most locations within the secured industrial area of PGDP were not considered candidate sites because they contain existing, operating facilities that are not scheduled to be decommissioned until well after the designated operational time frame of the potential waste disposal facility. Some areas outside the secured area of PGDP were also not considered that were in close proximity to streams, outside the DOE boundary, or too small in area (less than 110 acres). Additionally, no candidate sites were identified that crossed major roads, railroads, or creeks. One area located in the northernmost portion of the DOE boundary was not considered suitable because there was not enough contiguous property to accommodate the minimum site requirements due to the presence of the existing C-746-U Landfill in that area.

During the PSR, several significant siting features were noted and considered when selecting the candidate sites. One such feature was the location of the Porters Creek Terrace. The buried terrace lies immediately south, southeast, and southwest of PGDP, and it slopes northward beneath the southern

boundary of the PGDP fenced security area. Because the terrace serves as an aquitard, siting a waste disposal facility on top of the terrace would be effective in isolating the wastes from groundwater. Another important feature is the RGA, because it is the primary local aquifer. The RGA terminates against the terrace toward the southern part of PGDP and has areas of contaminated groundwater in distinct plumes north of the plant. A waste disposal facility that is located on top of the RGA in areas where groundwater is already impacted, would be preferable to a similar facility located on top of a pristine groundwater system. In the unlikely event of a hypothetical future release there would be less impact to groundwater in areas where groundwater is already contaminated. Additionally, "brownfield" sites were noted as significant siting features. A "brownfield" in this context refers to areas (1) contaminated by past DOE operations, (2) adjacent to or surrounded by contaminated areas, or (3) adjacent to or surrounded by waste management or disposal operations, regardless of whether contamination exists at the site. Siting a waste disposal facility in a "brownfield" area would have the advantage of reducing overall long-term commitment of land on PGDP and allow consolidation of operations that require long-term institutional controls. Brownfield sites include the Solid Waste Management Units (SWMUs) located within the DOE property boundary, both inside and outside the secured area of PGDP.

Ten potential candidate waste disposal facility sites were identified. Relevant features of these sites are described and discussed below.

In general all candidate sites, except Site 9, contain designated wetlands within their site boundaries. Wetland functions and values of the areas inside the plant are low to moderate with regard to groundwater recharge, floodwater retention, sediment/toxicant retention, and wildlife habitat. All sites, without exception, have overhead power lines that traverse the site area, although some sites have less area impacted by power lines than others. Sites 1, 2, and 10 are the only sites that do not contain designated SWMUs within their boundaries. There are no cultural resource areas within the boundaries of any of the 10 candidate sites. Figure 4.1 shows the locations of all 10 candidate waste disposal facility sites.

4.1.1 Site 1

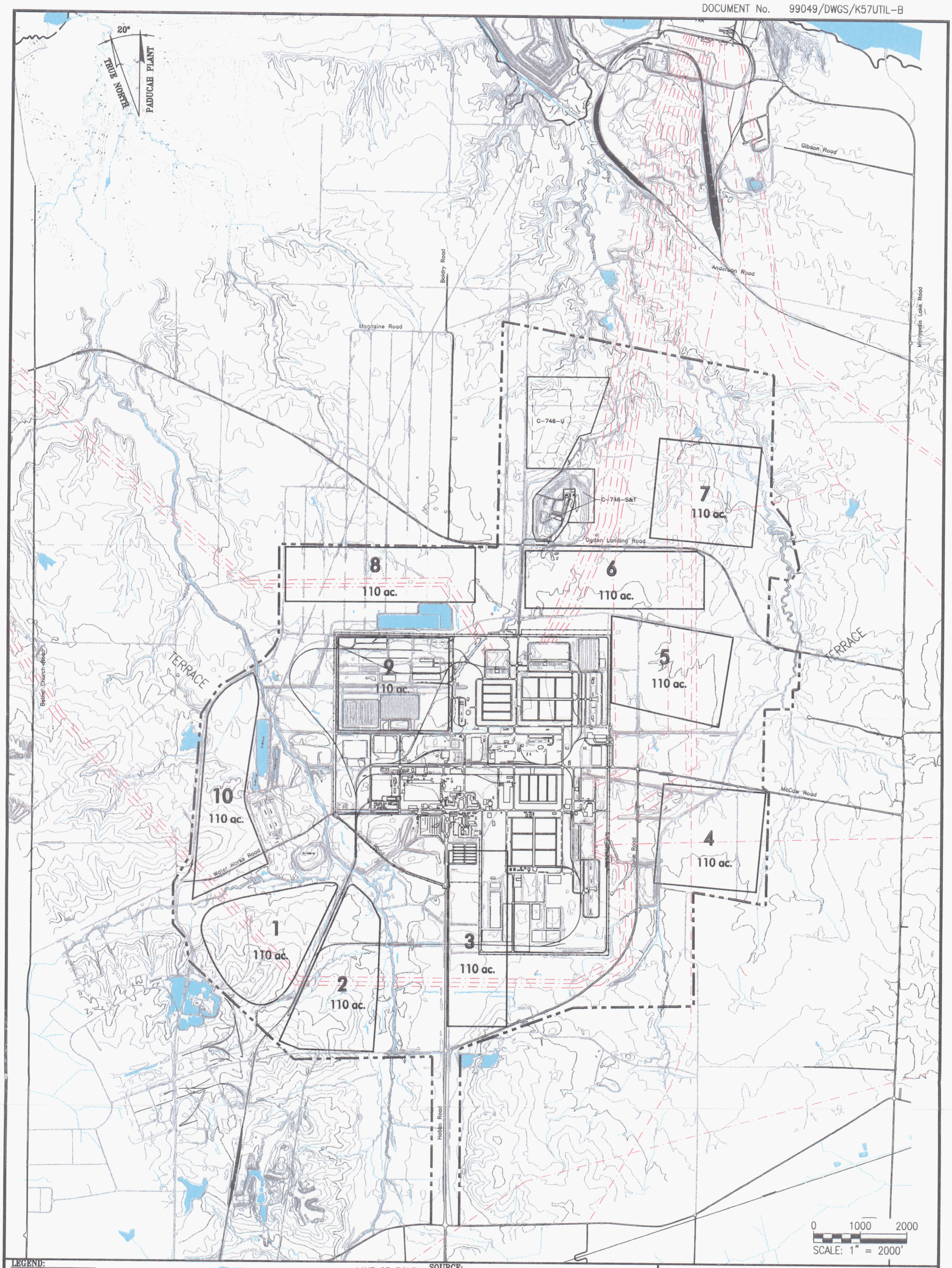
Site 1 is located outside the secured area of PGDP in the southwest corner of the DOE-owned property. The land use in this area is designated as recreational use-DOE property per the PGDP SMP. This site is located on top of the terrace gravels that consist of Pliocene-aged gravel deposits found at elevations higher than 350 ft amsl in the southern portion of the plant site. The Site 1 location is bordered by a Bayou Creek tributary to the north, Water Works Road to the west, railroad tracks to the east, and the DOE property boundary to the south.

There are transmission lines that run southeast and northwest through Site 1. In addition, this site encompasses an unnamed stream and road within its border.

4.1.2 Site 2

Site 2 is also located outside the secured area of PGDP in the southwest corner of the DOE-owned property. The land use in this area is designated as recreational use-DOE property per the PGDP SMP. This site is also located on top of the terrace gravels. This proposed location is bordered by Bayou Creek to the north and to the east, railroad tracks to the west, and an unnamed gravel road to the south.

Site 2 has transmission lines that run east and west through the center of the site. This site also has unnamed Bayou Creek tributaries within its borders.



LEGEND:

- BUILDINGS
- 1 PROPOSED LANDFILL SITE LOCATION
- ASPHALT ROADS
- DOE BOUNDARY
- TERRACE
- STREAM OR TRIBUTARY
- LAKE OR POND
- INDEX CONTOUR (25' INTERVAL)
- INTERMEDIATE CONTOUR (5' INTERVAL)
- OVERHEAD ELECTICAL UTILITY LINES

NOTE:
WORK AT PADUCAH GASEOUS DIFFUSION PLANT IS BEING DONE UNDER CONTRACT FOR THE US DEPARTMENT OF ENERGY.

SOURCE:
ELECTRICAL UTILITY LINES TAKEN FROM TOPOZONE MAP, 2000 UTM ZONE 16, N4108810, E 338808
C-746-S,T & U LANDFILL LOCATIONS TAKEN FROM PGDP 1998 ANNUAL ENVIRONMENTAL REPORT (FIGURE 9.7)

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-980R227000
Oak Ridge, Tennessee • Paducah, Kentucky, Ohio

Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 4.1. Locations of candidate waste disposal facility sites.

4.1.3 Site 3

Site 3 is located on the perimeter (primarily outside) of the secured area of PGDP in the south-central portion of the DOE-owned property. The proposed location is adjacent to and west of the UF_6 cylinder yards. The land use in the secured area is classified as industrial and the area outside the secured area is designated as recreational use-DOE property per the PGDP SMP. The site is bounded on the north by the C-810 Parking Lot; on the east by the C-745 Cylinder storage yards; on the south by a 161-kVA power line and right-of-way; and on the west by the main entrance roadway, Hobbs Road. The upper portion of the site is flat and covered with grasses over most of its extent; a ditch line midway along the northern section of the site discharges surface water to the west via KPDES Station 017. The lower portion of the site is relatively undisturbed, with the majority of the site containing trees, underbrush, and wetlands. This proposed site is also located on top of the terrace gravels.

The mid-to-upper portion of the proposed site is part of a contaminated site [i.e., Waste Area Grouping (WAG) 28, SWMU 194]. The site is also located just upgradient of existing contaminated areas.

Site 3 has transmission lines running east and west as well as a pond in the southern portion of the site. There is also an unnamed Bayou Creek tributary (man-made ditch) in the central portion of the site.

4.1.4 Site 4

Site 4 is located outside the secured area of PGDP in the southeastern portion of the DOE-owned property. The land use in this area is designated as recreational use-DOE property per the PGDP SMP. This site is bounded by McCaw Road to the north, Dyke Road to the west, the DOE boundary to the east and south, and a gravel patrol road to the south.

Site 4 is located on top of the terrace gravels. Little Bayou Creek runs southwest to north through Site 4. There are also two gravel roads, one in the northwestern portion and one that runs north to south in the eastern portion. Site 4 also has overhead transmission lines traversing through the site in two directions.

4.1.5 Site 5

Site 5 is outside the secured area of PGDP in the eastern portion of the DOE-owned property. The land use in this area is designated as recreational use-DOE property per the PGDP SMP. This site is bounded by an unnamed gravel road to the north, Dyke Road to the west, Little Bayou Creek to the east, and McCaw Road to the south.

There is a pond in the southwestern portion of Site 5. This site is located on top of the RGA that consists of the Quaternary sand and gravel facies of the lower continental deposits, and Holocene alluvium found adjacent to the Ohio River. Groundwater modeling has indicated that groundwater within the RGA beneath this site is the second slowest moving of five sites (i.e., Sites 5, 6, 7, 8, and 9) located above the RGA. Overhead transmission lines run north and south through this site.

4.1.6 Site 6

Site 6 is located outside the secured area of PGDP in the northern portion of the DOE-owned property. The land use in this area is designated as recreational use-DOE property per the PGDP SMP. Site 6 is bounded by Ogden Landing Road to the north and to the east, and an unnamed road to the west and to the south. This site is located on top of the RGA.

Overhead transmission lines run north and south through most of this site.

Modeling has indicated that groundwater within the RGA at this site moves the third slowest of five sites located above the RGA.

4.1.7 Site 7

Site 7 is located outside the secured area of PGDP in the northeastern portion of the DOE-owned property. The land use in this area is designated as recreational use-DOE property per the PGDP SMP. This site is bounded to the north, west, and east by the Little Bayou Creek tributaries and by Ogden Landing Road to the south. This site is located on top of the RGA. Overhead transmission lines run north and south through most of this site.

Several Little Bayou Creek tributaries are located within the boundary of this site.

4.1.8 Site 8

Site 8 is located outside the secured area of PGDP in the northeastern portion of the DOE-owned property. The land use in this area is designated as recreational use-DOE property per the PGDP SMP. The site is bounded by the DOE border to the north, an unnamed road to the west and to the east, and the C-616 Lagoons and the northern PGDP fence line to the south. This site is located on top of the RGA.

Site 8 encompasses small tributaries, former KOW facilities, and unnamed gravel roads within its 110 acres. Transmission lines run east and west through the middle of the site.

4.1.9 Site 9

Site 9 is located within the secured area of PGDP in the northwestern portion of the DOE-owned property. The land use in this area is designated as industrial per the PGDP SMP. This site is bounded by the PGDP fence line to the north and to the west, and plant roads to the east and to the south. This site is located on top of the RGA.

This candidate site is located within a "brownfield" area. There are at least 19 SWMUs contained within the designated boundaries of this site. Additionally, there are rail spurs within this candidate site's boundary. Another noted feature is the location of a raw water line; this feature could be beneficial because water would be potentially available on-site for decontamination of trucks and containers or for leachate treatment/cell operation.

4.1.10 Site 10

Site 10 is located outside the secured area of PGDP in the western portion of the DOE-owned property. The land use in this area is designated as recreational use-DOE property per the PGDP SMP. This site is bounded by an unnamed road to the north and to the west, C-611 facilities and Lagoons to the east, and a Bayou Creek tributary. Transmission lines cut across the southern tip of this site. This site is primarily located on top of the terrace; the northernmost tip of this site is on the RGA.

5. SITE SCREENING CRITERIA

5.1 GENERAL

Site screening criteria are generally defined as characteristics of a site or facility that influence decisions on design, construction, operation, or performance. Site screening criteria are often associated with sensitive environments that, because of their physical conditions, may be disturbed or permanently damaged by construction or operation of waste disposal facilities. Sensitive environments are also locations that are physically unstable and may change so greatly that they can cause the release of a hazardous waste or complicate its cleanup. Site screening criteria can also be defined as facility requirements that must be met to achieve operational goals.

Specific site screening criteria were established by evaluation of ARARs and review of existing literature on local geology, hydrology, seismic conditions, land use plans and other topographic features. Additional detail on siting ARARs is included in Appendix A. A summary of the site screening criteria used for siting a potential CERCLA waste disposal facility at PGDP is included in Table 5.1. A brief description of the criteria that pose special challenges to this siting process is included below.

5.1.1 Available Area

The first requirement that must be met in siting any type of facility is the availability of space. Unless adequate space is available to physically meet the facility requirements, no other evaluations are necessary. In the case of a potential on-site CERCLA waste disposal facility, a minimum required area of 110 acres was established. Additional constraints on available area were established by considering land as being available only if it is currently within the DOE-owned property boundary.

5.1.2 Floodplains

The proximity of a waste disposal facility to the 100-year floodplain is a major siting consideration. The 100-year floodplain is defined as any land area that is subject to a 1% or greater chance of flooding in any given year. For the waste disposal facility, floodplains were evaluated for the Ohio River as well as for Bayou and Little Bayou creeks.

Problems associated with flooding can include erosion of cover materials; washout of waste; slope stability problems; and saturation, leaching, and migration of wastes.

5.1.3 Seismic Considerations

If a waste disposal facility is constructed in a seismically active area, the facility must be located and designed to prevent damage to structures that hold wastes so as to prevent accidental release of hazardous constituents. Damage can result from movement of large pieces of ground (slope failure) or, more commonly, from ground shaking which can damage piping systems or cause liquefaction of soils. Regulatory requirements prohibit siting new hazardous waste disposal facilities within 200 ft of a Holocene fault (that is, a fault that has been active within the last 10,000 years).

Table 5.1. Site screening criteria for potential PGDP CERCLA waste disposal facility

Site screening criteria	Type of criteria	Requirement	Reference
Available Area	Threshold criteria	• Total waste volume: 3.1 million yd^3 • Area required for waste cell: 30 acres • Area required for waste cell and containment dike: 80 acres • Area required for support facilities: 30 acres • Total facility footprint: 110 acres	Initial Assessment of Consideration of On-Site Disposal of CERCLA Waste DOE/OR/07-1893&D1, July 2000
Available Area	Threshold criteria	• Locate entirely within DOE property boundary (no land purchase) • No relocation of Ogden Landing Road • Minimize impacts to existing facilities	DOE Programmatic requirement
Floodplains	Threshold criteria	• Avoid disposal in 100-year floodplain. If located in 100-year floodplain, must be designed to prevent washout • Cannot construct in floodway • Cannot restrict flow of the 100-year flood or reduce temporary water storage capacity of the 100-year flood so as to pose a hazard to human life, wildlife, or land or water resources	401 KAR 34:020 Section 9 Location Standards 902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal 40 *CFR* 264.18(b)(1) 10 *CFR* 61.50 Disposal Site Suitability Requirements for Land Disposal
Seismic Considerations	Threshold criteria	• Seismic considerations; facility will not be located within approximately 200 ft of a fault that has had displacement in Holocene time • Avoid areas where tectonic processes such as faulting, folding, seismic activity, or vulcanism may occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives	40 *CFR* 264.18 401 KAR 38:090 401 KAR 34:020 Section 9 (1) Location Standards 902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal

Table 5.1. Site screening criteria for potential PGDP CERCLA waste disposal facility (continued)

Site screening criteria	Type of criteria	Requirement	Reference
Hydrologic Considerations	Modifying criteria	• Provide sufficient depth to groundwater to prevent intrusion into the waste (TSCA has 50-ft buffer requirement) • Avoid proximity to drinking water wells, or high value groundwater • Cannot construct in seasonal high water table • Distance to perennial streams • Minimize upstream drainage area • Shall not discharge groundwater to the surface within the disposal site • Avoid areas of vulnerable hydrogeology	401 KAR 34:020 Section 9 (1) Location Standards 902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal 10 *CFR* 61.50 Disposal Site Suitability Requirements for Land Disposal
Wetlands	Modifying criteria	• Avoid disposal in wetland	902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal 10 *CFR* 61.50 Disposal Site Suitability Requirements for Land Disposal
Karst Soils	Modifying criteria	• Avoid placement within 250 ft of sinkhole (None known to exist at PGDP)	902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal
Unstable Terrain	Modifying criteria	• Avoid surface geologic processes such as mass wasting, erosion, slumping, landsliding, or weathering with a frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives • Avoid areas of potential liquefaction	902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal 10 *CFR* 61.50 Disposal Site Suitability Requirements for Land Disposal 40 *CFR* 761.75 (b)(5)
Unfavorable Weather Conditions	Modifying criteria	• Avoid stagnant weather conditions, non-attainment areas, etc. (None known to exist at PGDP)	EPA Siting Guidance
Incompatible Land Use	Modifying criteria	• Avoid areas where nearby facilities or activities could adversely impact the ability of the site to meet the performance objectives • Avoid areas of existing contamination • Industrial land use preferred over recreational land use	902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal DOE 435.1 DOE Programmatic requirement

Table 5.1. Site screening criteria for potential PGDP CERCLA waste disposal facility (continued)

Site screening criteria	Type of criteria	Requirement	Reference
Transportation/ Access	Modifying criteria	• Optimize site access from sources of waste generation to minimize adverse environmental or public impacts during shipment to the waste disposal facility • Minimize replacement or construction of roads or rail lines	NEPA transportation impacts
Buffers	Modifying criteria	• Distance to sensitive environmental areas (including WKWMA) • Distance to site boundaries • TSCA requirement for 50-ft buffer between the bottom of the landfill and the top of the water table • Avoid placement within 250 ft of perennial stream	40 *CFR* 761.75(b)(3)
NEPA Considerations	Modifying criteria	• Threatened & Endangered Species (Indiana bat habitat areas), • Historic/archaeological sites (cemetaries) • Avoid areas having known natural resources which, if exploited, would result in failure to meet the performance objectives	902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal 10 *CFR* 61.50 Disposal Site Suitability Requirements for Land Disposal EPA 2000
Demographic Considerations	Modifying criteria	• Located in area where projected population growth and future developments are not likely to affect the ability of the disposal facility to meet the performance objectives • Avoid impacts to low income or minority populations • Distance to nearest church, school, house, well	902 KAR 100:021, Section 22 Disposal Site Suitability Requirements for Land Disposal 10 *CFR* 61.50 Disposal Site Suitability Requirements for Land Disposal EPA 1997 Programmatic requirements
Programmatic Considerations	Final criteria	• Time frame for availability of facility in relation to other CERCLA actions, cost of development	CERCLA, NCP Programmatic requirements

Seismic design considerations are being further evaluated in the RI/FS based on discussions with EPA and the Commonwealth of Kentucky. At the present time, seismic considerations are not expected to impact the viability of a waste disposal facility. However, it is possible that future development of seismic design criteria, such as peak ground acceleration, could impact the cost-effectiveness of a potential facility.

5.1.4 Hydrologic Considerations

Hydrologic impacts to or from waste disposal facilities can include both surface water and groundwater. Surface water run-on to a site can result in erosion and eventual loss of waste containment. Discharges to surface streams have the potential to impact human and ecological receptors and must be considered in siting and design of a facility.

Groundwater considerations include depth to groundwater, seasonal fluctuations in groundwater, and water quality issues. Areas with shallow groundwater or large seasonal fluctuations in groundwater may require dewatering systems or aboveground facilities. Highly permeable soils and bedrock may transport contaminants over large distances and should be avoided. Areas containing high value groundwater that is the sole source of drinking water or groundwater that feeds into sensitive environments such as wetlands are of particular concern.

5.1.5 Wetlands

Problems associated with locating waste disposal facilities in or near wetlands include the potential loss or impact to fish and wildlife habitat, drainage problems, and constructability concerns. Wetlands typically contain large quantities of soils that are unsuitable for construction and involve increased construction costs.

5.1.6 Unstable Terrain

Unstable terrain is any area where movement of the land surface can damage structures or facilities. Unstable terrain is divided into two kinds of land movement: (1) the movement of rock and soil on steep slopes by gravity (e.g., landslides); and (2) rock and soil sinking, swelling, or heaving. Unstable soils can damage containment systems, leading to spills and releases. Mass movement of soil and rock, or poor foundation conditions, can cause tears in liner systems, breaks in leachate collection piping, and failure of earthen containment dikes. Although most risks to facilities in unstable terrain can be addressed by proper design and engineering, construction and maintenance costs would increase due to the potential need for foundation reinforcing systems or more frequent repairs of damages resulting from unstable land movement.

5.1.7 Incompatible Land Use

Certain pre-existing land uses may not be compatible with the construction or operation of a waste disposal facility. For example, densely populated areas or facilities such as churches, hospitals, or schools are particularly sensitive. Existing facilities that would require removal or replacement at significant cost, or areas of existing contamination that could prevent adequate monitoring, should also be avoided.

5.2 CLASSIFICATION OF CRITERIA

Site screening criteria were arranged in multiple levels to allow early elimination of sites determined not to be technically feasible. Site screening criteria were divided into three general categories.

1. Threshold Criteria: Those criteria that would tend to eliminate a site early in the screening process. Threshold criteria were defined as having one or more of the following characteristics:

   - Regulatory requirements that prohibit construction of a facility in a particular area (e.g., seismic considerations, distance to Holocene faults, and floodplain areas).

   - Technical considerations that would make construction of a disposal facility on a particular site infeasible (e.g., minimum land requirements).

   - Land ownership considerations (e.g., site must be located within existing DOE-owned property).

2. Modifying Criteria: Those criteria that, when considered alone or with other modifying criteria, could directly or indirectly affect the ability of a facility to meet its performance requirements or would render development of the facility technically impractical or cost prohibitive. Modifying criteria are more flexible than threshold criteria; if a site does not meet the objectives of a modifying criterion, efforts should then be focused on mitigating measures. Modifying criteria include the following:

   - Regulatory considerations
   - Physical and topographic characteristics of the site
   - Impacts on current or future resources
   - Technical considerations

3. Final Criteria: Other criteria deemed by DOE or other stakeholders to directly affect selection of a site. These may include the following:

   - Programmatic considerations, such as decisions on site remediation or long-term land use, that cannot be resolved in a time frame consistent with project schedules.

The threshold criteria are applied in the preliminary screening of sites in Chap. 6. The modifying and final criteria are applied in the final screening of sites in Chap. 7.

6. PRELIMINARY SCREENING

The site screening process is an iterative process that applies screening criteria in successive steps to subsequently identify sites that will be carried forward for evaluation in the RI/FS. As indicated in Chap. 4, a PSR was conducted prior to the Preliminary Screening. The PSR involved evaluating site conditions at PGDP to identify areas that could be suitable for locating a potential CERCLA waste disposal facility. As a result of the PSR, ten candidate sites were identified for preliminary screening, as described in Chap. 4.

Preliminary screening of the ten candidate sites is the next step in the overall site screening process. This screening evaluates the ten candidate waste disposal facility sites against the following designated threshold criteria:

- available area,
- floodplains, and
- seismic considerations.

Candidate sites must meet these threshold criteria in order to pass the preliminary screening and be carried forward to the final screening. A discussion of the preliminary screening criteria and the subsequent results of this screening process follows in the sections below. Table 6.1 provides a summary of the results of the screening criteria evaluation for each candidate site.

6.1 AVAILABLE AREA

Based on projected waste volumes and cell design assumptions, the disposal cell was estimated to require a contiguous area of 80 acres, with a total waste disposal facility footprint of 110 acres, including roads and support facilities. For purposes of this screening discussion, 110 acres was selected as a model footprint area. Figure 2.1 shows the 110-acre footprint outline for a conceptual site.

All ten candidate sites satisfy the prescribed 110-acre area criterion. The sites are primarily rectangular or square in shape, although some sites have irregular shapes in order to avoid unacceptable areas (e.g., prominent floodplain areas, existing facilities). Additionally, all ten sites are within the DOE property boundary. Areas that are currently occupied or planned to be occupied within Sites 3 and 9 would need to be made available. Currently, UF_6 cylinders are located at Site 3, and a future UF_6 conversion facility is planned for that area. Site 9 includes several SWMUs, including burial grounds and scrap metal yards, and several buildings, including the following: C-616 Facility is still active and not scheduled for D&D until 2012; C-746 Facility is still active; C-726 Small Sand Blasting Facility is possibly still in use; and two major storage facilities (C-752A and C-753A) were recently built north of SWMU 200.

6.2 FLOODPLAINS

KAR and *CFR* requirements indicate that floodplain areas should be avoided. The primary focus of these requirements is that the area for the waste cell be well drained and free of areas of flooding or frequent ponding. However, if floodplain areas are unavoidable, then the design must prevent washout.

Table 6.1. Preliminary screening: Threshold criteria

Site number	CRITERIA					Comments
	Threshold					
	Insufficient area	Not within DOE boundary	Facility demolition required	Prominently located within 100-year floodplain	≤ 200 ft of Holocene faults & lineaments	
Site 1						
Site 2				X		Eastern portion of the site is prominently located in Bayou Creek floodplain.
Site 3			X (minor)			Site contains 2 SWMUs that would need to be addressed.
Site 4				X		Western portion of the site is prominently located in Little Bayou Creek floodplain.
Site 5						
Site 6						
Site 7				X		Northeastern corner of the site is prominently located in Little Bayou Creek floodplain.
Site 8						
Site 9			X (minor)			Site contains 19 SWMUs and 8 facilities that would need to be addressed. Final facility design could possibly avoid lineament feature.
Site 10				X		Northern portion of the site is prominently located in Bayou Creek floodplain.

Portions of Sites 1, 2, 4, 7, and 10 are located within the 100-year floodplain. Sites 2, 4, 7, and 10 have areas prominently located within Bayou Creek and Little Bayou Creek floodplains and have the potential to impact the waste cell area; therefore, these sites are eliminated from further consideration. Site 1, however, has only the upper northern fringe of the site impacted by the Bayou Creek floodplain and thus would have to include a design to prevent washout if selected (Fig. 6.1).

6.3 SEISMIC CONSIDERATIONS

Regulatory requirements [e.g., 401 KAR 34:020 Section 9(1) Location Standards] stipulate that a disposal facility cannot be located within approximately 200 ft of a fault that has had displacement in Holocene time. The requirements also indicate that tectonic processes (e.g., faulting, folding, seismic activity, or vulcanism) should be avoided where they occur with such frequency and extent to significantly affect the ability of the disposal site to meet the performance objectives.

No faults having had displacement in Holocene time have been found in any areas of the DOE-owned property (DOE 2000b); therefore, all ten sites technically meet this requirement. However, Drahovzel and Hendricks (1996) have postulated the presence of structural lineaments running SW-NE across the area, and Street and Langton (1998) have postulated the presence of two faults (undetermined age) shown on Fig. 6.2. In addition, seismic reflection studies indicate that faulting of the bedrock and at least some of the overlying sediments is pervasive at PGDP (Street and Langston 1998). Based on information reviewed to date, DOE has concluded that these faults have not had displacement in Holocene time. These postulated faults and lineaments are documented for reference and may be considered significant issues that stakeholders will want to address if any of the sites impacted by the faults and lineaments are selected at some future time. Furthermore, the most conservative approach would be to investigate these faults and lineaments during any subsequent characterization efforts.

In order to be conservative and ensure protection of human health and the environment, these postulated lineaments and faults are also to be avoided during this siting study, even though they are not thought to be of Holocene age. Only Sites 4 and 7 either avoid or are located more than 200 ft from the postulated faults and lineaments. Evaluation of existing available seismic and tectonic information is ongoing and is being coordinated with preparation of the RI/FS report. Given the present uncertainty regarding the existence of lineaments and the age of faults, all potential sites were considered essentially equivalent from a seismic perspective.

6.4 RESULTS OF PRELIMINARY SCREENING

Sites 2, 4, 7, and 10 were eliminated during the preliminary screening based on the floodplain criterion; therefore, Sites 1, 3, 5, 6, 8, and 9 were carried forward to the next phase of the screening process (i.e., final screening based on modifying criteria).

THIS PAGE UNAVAILABLE
FOR
PUBLIC RELEASE

IF YOU WISH TO VIEW,
PLEASE CALL
BECHTEL JACOBS SECURITY
(PHONE: 441-5037)

THIS PAGE UNAVAILABLE
FOR
PUBLIC RELEASE

IF YOU WISH TO VIEW,
PLEASE CALL
BECHTEL JACOBS SECURITY
(PHONE: 441-5037)

7. FINAL SCREENING

The six technically feasible candidate sites that passed the preliminary screening (i.e., Sites 1, 3, 5, 6, 8, and 9) are evaluated during this final screening process. This phase of the screening process provides an opportunity to further eliminate less desirable sites or highlight the benefits of more preferred sites based on modifying criteria (e.g., hydrologic considerations, incompatible land use). The modifying criteria are more flexible than the threshold criteria; if a site does not meet the objectives of a modifying criterion, efforts should then be focused on mitigating measures.

Following the Preliminary Screening, evaluation of the data resulted in the sites being grouped into three general areas within the DOE-owned property based on similar controlling features. The sites were grouped according to:

- **Sites located on the Porters Creek Terrace (Sites 1 and 3).** As discussed in Sect. 3.4, the Porters Creek Clay formation can reach depths of 100 ft in areas south of the PGDP site. The clay forms the dominant feature in the movement of groundwater and surface water in the area and would be considered a positive feature for siting of a waste management facility. ARARs such as TSCA regulations 40 *CFR* 761 stipulate that, if possible, disposal facilities should be placed on sites with thick, impermeable formations such as clay.

- **Sites located within the secured area and above the RGA; "brownfield" site (Site 9).** This site is located within the secured area of PGDP in an area of known contamination of soil and groundwater.

- **Sites located outside the secured area and above the RGA (Sites 5, 6, and 8).** All three sites (i.e., Sites 5, 6, and 8) are located above the RGA in areas outside the security fence. Sites located above the RGA tend to have similar characteristics that affect contaminant fate and transport.

After grouping the sites into these three areas, the sites were compared against each other for final screening. Following final screening, a final candidate site was selected from each area for further evaluation in the RI/FS.

7.1 HYDROLOGIC CONSIDERATIONS

Hydrologic considerations include such elements as a 50-ft depth to groundwater buffer, minimizing upstream drainage areas, and avoiding discharge of groundwater to surfacewater within the disposal site. The upstream drainage areas and groundwater-to-surface discharge requirements (e.g., seeps and springs) are concerned with the amount of runoff that could erode or inundate the waste disposal unit. Other items include not constructing the site in a seasonal high water table and avoiding close proximity to drinking water wells (Fig. 7.1).

Much of the PGDP area has a shallow perched water table overlying the RGA. Based on available information, none of the sites have the sufficient 50-ft depth to groundwater buffer required by TSCA; therefore, a waiver of these buffer requirements will be needed (see Section 7.8). Because all residents within the DOE Water Policy Boundary (Fig. 7.1) are provided with the option of receiving municipal water and no longer have to use their wells for personal consumption, the public is currently protected from potential impacts at all candidate sites. The RI/FS will evaluate long-term protectiveness of human health and the environment. Sites that are farther from perennial streams are preferred over sites that are closer to perennial streams, in case of an inadvertent release. The candidate sites and their respective

THIS PAGE UNAVAILABLE
FOR
PUBLIC RELEASE

IF YOU WISH TO VIEW,
PLEASE CALL
BECHTEL JACOBS SECURITY
(PHONE: 441-5037)

distances are as follows: Site 6 (~2000 ft); Sites 3, 8, and 9 (~1000 ft); and Sites 1 and 5 (~100 ft). Site 6 is the only site that does not have some form of drainage system, creek, or tributary on it. The measure to mitigate or minimize this area and the others would require rerouting of these surface water sources.

Gaining reaches of Bayou Creek are found south of PGDP and north of the plant in the Ohio River floodplain; as such, there is the potential for groundwater discharge within Sites 1 and 3 due to their location within their watershed and on the terrace. In contrast, gaining reaches of Little Bayou Creek are limited to the Ohio River floodplain; thus, neither of the candidate sites located within this watershed (i.e., Sites 5 and 6) have any identified sources that would permit groundwater discharge within its borders. Additionally, the terrace gravels are considered vulnerable hydrogeology for Sites 1 and 3, and the RGA is considered vulnerable hydrogeology for Sites 5, 6, 8, and 9.

The rate of groundwater movement within the RGA is another important site screening criterion, because it influences the spread of contaminant transport and subsequent impacts in the event of a release. Therefore, candidate sites with slower groundwater movement rates are considered better than those with faster moving rates. A groundwater model indicated that groundwater movement is slowest at Site 9, followed by Sites 5, 6, and 8, respectively.

7.2 WETLANDS

CFR and KAR disposal site suitability requirements indicate that wetland areas should be avoided. This ties into the requirement that the site be well drained and free of flooding or frequent ponding (Fig. 7.2).

Site 9 is the only area that does not contain a wetland of any type. The other five sites would require varying amounts of wetland mitigation work. Wetland mitigation measures typically require restoration at a ratio of 2:1. The sites were ranked in relative order based on the amount of wetland area within the perimeter of the site. Site ranking from least percentage of designated wetland area to most percentage of wetlands is Site 9 (least or < 1%), Site 6 (~10%), Sites 5 and 1 (~20%), Site 3 (~30%), and Site 8 (most or ~90%).

7.3 KARST SOILS

KAR requirements indicate there should be no placement of the site within 250 ft of a sinkhole.

There are no limestones within 300 ft of the ground surface, so karst is not a problem at any of the proposed sites.

7.4 UNSTABLE TERRAIN

*CFR*s and KARs indicate that areas with significant surface geologic processes (e.g., mass wasting, erosion, slumping, landsliding, or weathering) be avoided, as well as areas of potential liquefaction.

There are no known areas of unstable terrain at PGDP. Available information suggests that no liquefaction or ground failures occurred in the upland surface at the present PGDP during the New Madrid 1811-1812 earthquakes (DOE 2000b). Site-specific soil modeling studies performed for PGDP by the U.S. Army Engineer Waterway Experimental Station (WES) assessed the potential for liquefaction

THIS PAGE UNAVAILABLE
FOR
PUBLIC RELEASE

IF YOU WISH TO VIEW,
PLEASE CALL
BECHTEL JACOBS SECURITY
(PHONE: 441-5037)

and earthquake-induced settlement using a site response analysis (Sykora and Davis 1993). The results of this dynamic modeling indicated that liquefaction should not occur in the event of a 1000-year seismic event.

Sites located above the Porters Creek Clay (Site 1 and most of Site 3) would also be less susceptible to liquefaction. Liquefaction typically occurs in more granular soils that are saturated and fluidized by the seismic event. The location of the Porters Creek Clay formation relative to the ten original candidate sites is shown in Fig. 7.3.

7.5 UNFAVORABLE WEATHER CONDITIONS

EPA Siting Guidance calls for avoidance of stagnant weather conditions and non-attainment areas.

PGDP is an attainment area for all measured pollutants, and there are no structural or land mass features that would preclude construction of a land disposal facility based on unfavorable weather conditions.

7.6 INCOMPATIBLE LAND USE

Areas with nearby facilities or activities that could adversely affect the ability of the site in meeting its performance objectives are to be avoided, as are areas of existing contamination (Fig. 7.4).

Candidate Sites 5, 6, 8, and 9 are within the trichloroethene-contaminated groundwater plume. In addition, Sites 3, 5, and 9 contain SWMUs within their borders. Site 9 contains a total of 19 units, the most SWMUs among the 4 sites. The schedule for closure of those 19 SWMUs ranges between fiscal years 2005 and 2010. Additionally, there are eight active facilities (745b&c, 746a&b, 616, 726, 752a, and 753a) on Site 9 that are not scheduled for D&D until between fiscal years 2012 and 2023. PGDP is surrounded by the WKWMA, rural residential, and agricultural land (see Fig. 3.2). There are no current facilities or planned activities that would adversely impact the ability of a waste disposal facility to meet its performance objectives.

Site 9 is the only candidate site that currently has an industrial land-use designation. The other five candidate sites (i.e., Sites 1, 3, 5, 6, and 8) are all designated as recreational use-DOE owned property.

7.7 TRANSPORTATION/ACCESS

NEPA criteria call for site access to be optimized to minimize adverse impacts during shipment to a waste disposal facility. This criterion also calls for minimization of transportation impacts.

All candidate sites are within the DOE property boundary and are accessible.

7.8 BUFFERS

Specific *CFRs* (e.g., wetlands, areas with highly erodible soil, soil subject to liquefaction) require that buffers be provided between waste and groundwater, sensitive environmental areas, site boundaries, and perennial streams (see Fig. 7.1).

THIS PAGE UNAVAILABLE
FOR
PUBLIC RELEASE

IF YOU WISH TO VIEW,
PLEASE CALL
BECHTEL JACOBS SECURITY
(PHONE: 441-5037)

THIS PAGE UNAVAILABLE
FOR
PUBLIC RELEASE

IF YOU WISH TO VIEW,
PLEASE CALL
BECHTEL JACOBS SECURITY
(PHONE: 441-5037)

No sites meet the TSCA requirement of ≥50-ft buffer between the proposed landfill and the water table. Therefore, waiver of the TSCA requirement would be required. This request for a waiver would be justified on the basis of demonstrated equivalent or superior protectiveness of the design. The EPA Region 4 administrator and other representatives of the FFA parties would be consulted with respect to this request. There is a provision for obtaining this waiver based on an equivalent standard of performance [40 *CFR* 300.4 and CERCLA Sect. 121(d)]. EPA has granted such waivers at other facilities within EPA Region 4 including the Oak Ridge EMWMF.

Sites 3, 6, 8, and 9 are the only sites that meet the ≥250-ft distance to perennial streams.

7.9 NEPA CONSIDERATIONS

NEPA considerations involve analyzing the effects of an action on areas or habitats protected by other acts (e.g., T&E species, historic/archaeological sites, and areas having known natural resources). NEPA stipulates that any adverse effects on these areas or habitats be minimized and/or mitigated. NEPA values will be incorporated into this project's CERCLA documentation in accordance with the DOE Secretarial Policy on NEPA (DOE 1999).

No T&E species or potential habitat for any T&E species have been observed inside the secured area of PGDP. A mist-netting survey was conducted in 1999 near PGDP, and five Indiana bats were captured near the lower downstream reaches of Bayou Creek about 2 miles from PGDP (KDFWR 2000).

Ten federally listed, proposed, or candidate species have been identified as potentially occurring at or near PGDP (see Table 3.1). None of the species has been reported as sighted on DOE property, although potential summer habitat exists within the southern region of Site 1 for the Indiana bat (Fig. 7.5). No critical habitat for any of these species has been designated anywhere in the study area (BJC 2000a).

There are no known cultural resource sites within the boundaries of any of the six candidate sites. Site 6 is, however, located adjacent to Harmony Cemetery.

The Tupelo Swamp, considered to be a very unusual ecosystem, is located near the edge of the Ohio River. This natural resource is approximately 2 miles from the nearest proposed site.

7.10 DEMOGRAPHIC CONSIDERATIONS

EPA's Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations,* requires that impacts to minority and low-income populations be avoided. Detailed environmental justice evaluations will be completed in the RI/FS to assess any potential impacts to minority or low-income populations as a result of implementing any of the alternatives being considered for disposal of CERCLA-derived waste from PGDP. Currently, no minority or low-income populations have been identified or are located near any of the candidate site locations.

Additionally, areas where projected population growth and future developments are likely to affect a site's performance objective are also to be avoided. The projected land use in all areas of DOE-owned property is designated as recreational or industrial; surrounding land use is designated as recreational or rural residential. Therefore, there are no impacts of projected population growth or future developments on any of the sites.

LEGEND:

- BUILDINGS
- 1 PROPOSED LANDFILL SITE LOCATION
- ASPHALT ROADS
- DOE BOUNDARY
- TERRACE
- STREAM OR TRIBUTARY
- LAKE OR POND
- BAT HABITAT

NOTE:

WORK AT PADUCAH GASEOUS DIFFUSION PLANT IS BEING DONE UNDER CONTRACT FOR THE US DEPARTMENT OF ENERGY.

U.S. DEPARTMENT OF ENERGY
DOE OAK RIDGE OPERATIONS
PADUCAH GASEOUS DIFFUSION PLANT

BECHTEL JACOBS COMPANY, LLC
MANAGED FOR THE US DEPARTMENT OF ENERGY UNDER US GOVERNMENT CONTRACT DE-AC-05-98OR22700
Oak Ridge, Tennessee • Paducah, Kentucky, Ohio

SAIC
Science Applications International Corporation
P.O. Box 2502
Oak Ridge, Tennessee 37831

Fig. 7.5. Bat habitats.

Sites 1, 3, 5, and 6 are all located less than 1 mile from the nearest public facility (i.e., church or school). Sites 8 and 9 are within 3 miles of the nearest public facility. Sites 8 and 9 are the candidate sites noted to be farthest from the residential areas, whereas Sites 1 and 5 are the candidate sites in closest proximity to residential areas.

7.11 PROGRAMMATIC CONSIDERATIONS

In addition to the previous ten criteria, there are programmatic considerations that may impact siting requirements. One such consideration is availability/time frame of the proposed waste disposal facility with respect to other CERCLA actions. Other considerations include utilities in the area and cost of development.

Site 9 contains numerous SWMUs (one of which contains pyrophyric uranium) that may require remediation before construction of a waste disposal facility could begin. Unless actions on these SWMUs are expedited, the project schedule for a waste disposal facility could be delayed.

Other actions that could impact proposed sites include stormwater retention basins and permeable treatment zones for groundwater remediation.

Based on current information, all sites may require rerouting of overhead power lines, streams, diversion ditches, and/or railroad spurs. In addition candidate Site 3 is designated in the location of the proposed DUF_6 Conversion Facility Site. Additionally, Site 9 has a 30- to 40-inch raw water line in the southeastern portion.

The presence of power transmission lines traversing the sites may be a severe restriction to site development. If on-site disposal in a CERCLA waste disposal facility were to be selected for implementation at PGDP, the detailed design would need to explore alternate site configuration and support facility layouts to avoid the power lines. Rerouting of power lines is very difficult and costly due to TVA easement issues, construction cost impacts, and continuation of power service to PGDP and other TVA customers.

None of the sites required that Ogden Landing Road be relocated to meet the available area requirement.

7.12 SELECTION OF FINAL CANDIDATE SITES

The six sites that passed the Preliminary Screening were grouped into three general areas within the DOE-owned property boundary based on controlling features. The sites were grouped according to:

- Sites located on the Porters Creek Terrace (Sites 1 and 3);
- Sites located within the secured area of PGDP and above the RGA; "brownfield" site (Site 9); and
- Sites located outside the secured area and above the RGA (Sites 5, 6, and 8).

After grouping the sites into these three areas, the sites were compared against each other for final screening, and a final candidate site was selected from each group for further evaluation in the RI/FS. A summary of the Final Screening is shown in Table 7.1.

Within the Porters Creek Terrace group, Site 1 was selected for further evaluation in the RI/FS. Because Site 1's location is further back on the terrace than Site 3 Site 1 would provide greater protection

of groundwater by preventing contamination of the RGA. Proximity to the postulated lineaments is approximately equal between Sites 1 and 3 if it is assumed that the lineament immediately southwest of Site 3 continues through the site. The primary reason Site 1 was selected over Site 3 for further evaluation in the RI/FS is because of a programmatic conflict involving future land use. The area in the vicinity of Site 3 has been selected as the location for construction of the new DUF_6 Conversion Facility. A characterization report dated September 2000 has been prepared to look at Site 3 as the new DUF_6 Conversion Facility (BJC 2000b). If a decision were made not to construct the DUF_6 facility, Site 3 would be considered as a strong candidate site because of its proximity to the industrial complex. The general shape of Site 3, which is long and narrow, could, however, present problems on cell configuration. The location of Site 3 adjacent to the main PGDP entrance is also considered a negative because of increased traffic in the area, which could result in increased problems with unauthorized access. The location would also not be considered aesthetically pleasing at the entrance to PGDP.

As the only site in the "brownfield" group, Site 9 was selected for further evaluation in the RI/FS. As noted earlier, there are significant benefits in a disposal site being located in a brownfield area. Among other things, this would reduce the environmental impact because the site would already be in a contaminated area or surrounded by areas of contamination. Site 9 is also the only site located entirely within the PGDP security fence and having an industrial land use designation.

Of the remaining sites outside the secured area and above the RGA, Site 5 was identified as the site selected for further evaluation in the RI/FS. There are no postulated faults and lineaments, nor are there floodplains within Site 5. Site 5 also contains fewer wetlands than Site 8 and has fewer power transmission lines than either Site 6 or Site 8. Additionally, Site 5 is designated in an area where groundwater within the RGA is the slowest moving of the three sites (i.e., Sites 5, 6, and 8) and would therefore likely be more protective of human health by isolating the wastes.

A more detailed discussion on the rationale for selecting each site for further evaluation in the RI/FS is contained in Chap. 8.

Table 7.1. Site comparison for potential CERCLA waste disposal facility

			Terrace		RGA			Brownfield
		Criteria	Site 1	Site 3	Site 5	Site 6	Site 8	Site 9
THRESHOLD CRITERION	**Available Area**	110-acre available area	Yes	Yes	Yes	Yes	Yes	Yes
		Within DOE boundary	Yes	Yes	Yes	Yes	Yes	Yes
		Facility demolition required?	No	Yes	No	No	No	Yes
	Floodplains	Prominently located within 100-year floodplain	No < 1%	No 0%	No < 10%	No 0%	No 0%	No < 1%
	Seismic Considerations	≥ 200 ft of Holocene faults & lineaments	Yes, exceeds criterion	Yes, exceeds criterion	Yes, exceeds criterion	Yes, exceeds criterion	Yes, exceeds criterion	Yes, exceeds criterion
MODIFYING CRITERION	**Hydrologic Considerations**	≥50 ft depth to groundwater	No, <15 ft	No, ≤ 15 ft	No, ≤40 ft	No, ≤40 ft	No, ≤40 ft	No, < 15 ft
		Distance to drinking water wells[1]	See note 1	See note 1	See note 1	See note 1	See note 1	See note 1
		Distance to perennial streams	~100 ft	~1,000 ft	< 100 ft	~2,000 ft	~1,000 ft	~1,000 ft
		Upstream drainage areas	No	No	No	No	No	No
		Groundwater discharge within the proposed waste disposal facility site	Gaining in Bayou Creek	Gaining in Bayou Creek	Losing in Little Bayou Creek	Losing in Little Bayou Creek	Losing in Little Bayou Creek	Losing in Bayou Creek
		Vulnerable hydrogeology	Yes (gravel)	Yes (gravel)	Yes (plume)	Yes (plume)	Yes (plume)	Yes (plume)
		Rate of groundwater movement on the RGA	N/A, site not on RGA	N/A, site not on RGA	Slow movement	Slow movement	Moderate movement	Slowest movement
	Wetlands	Designated wetland area	Yes (~20%)	Yes (~30%)	Yes (~20%)	Yes (~10%)	Yes (~90%)	No (~1%)
	Karst Soils	Distance to karst ≥250 ft	Yes	Yes	Yes	Yes	Yes	Yes
	Unstable Terrain	Surface geologic processes	No	No	No	No	No	No
		Areas of potential liquefaction	No per WES Model	No per WES Model	No per WES Model	No per WES Model	No per WES Model	No per WES Model
	Unfavorable Weather	Stagnant weather conditions	No	No	No	No	No	No
	Incompatible Land Use	Adverse impacts from nearby facilities	No	No	No	No	No	No
		Areas of existing contamination (SWMUs)	No	Yes	Yes	Yes	Yes	Yes
		Industrial vs. recreational land use	No	No	No	No	No	No
	Transportation Access	Site access	Accessible	Accessible	Accessible	Accessible	Accessible	Accessible
		Impacts to roads/railroads	Yes, road	Yes, road & railroad	No	No	Yes, road	No
	Buffers	Distance to sensitive environmental areas	~ 5 Miles	~ 5 Miles	~ 5 Miles	~ 5 Miles	~ 5 Miles	~ 5 Miles
		Distance to DOE boundaries	≤100 ft	≤100 ft	≤700 ft	≤50 ft	≤50 ft	≤1,300 ft
		≥50-ft buffer between landfill and water table	No < 20 ft	No < 20 ft	No ≤50 ft	No ≤50 ft	No ≤50 ft	No ≤20 ft
		≥250 ft to streams	No	Yes	No	Yes	Yes	Yes
	NEPA Considerations	T&E species	None observed, potential bat habitat in southern portion of site	None observed	None observed	None observed	None observed	None observed
		Historical & archaeological sites	No	No	No	No	No	No
		Natural resource area (Tupelo Swamp)	< 3 miles	< 3 miles	< 2 miles	< 2 miles	< 2 miles	< 2 miles
	Demographic Considerations	Effects on projected population growth	None	None	None	None	None	None
		Distance to schools, church, houses, etc.	<1 mile	< 1 mile	< 1 mile	< 1 mile	< 3 miles	< 3 miles
FINAL CRITERION	**Programmatic Considerations**	Availability/time frame of facility vs. other actions	2004	2004 vs. DUF_6 schedule	2004	2004	2004	2004 vs. SWMU remediation schedule
		Length of postulated faults or lineaments	~1,500 ft	~500 ft	~1,800 ft	~1,300 ft	~1,300 ft	~3,500 ft
		Relocation of Ogden Land Road required?	No	No	No	No	No	No
		Other considerations	Requires rerouting of streams and ~6,600 ft of power lines	Proposed DUF_6 Conversion Facility Site, requires rerouting of streams and ~4,000 ft of power lines	Requires rerouting of streams and ~8,000 ft of power lines	Requires rerouting of ~13,200 ft of power lines	Requires rerouting of streams and ~12,000 ft of power lines, raw water line	Requires rerouting of diversion ditch and raw water line

1. Residences within the DOE Water Policy Boundary are provided with municipal water.

8. FINDINGS AND RECOMMENDATIONS

The Final Screening step described in Chap. 7 closely examined the six candidate sites remaining after preliminary screening, applied modifying screening criteria and programmatic considerations to the evaluation, and grouped the sites into one of three general areas with distinctively different characteristics:

- Sites located outside the secured area and on the Porters Creek Terrace (Sites 1 and 3);
- Sites located within the secured area of PGDP and above the RGA, "brownfield" site (Site 9); and
- Sites located outside the secured area and above the RGA (Sites 5, 6, and 8).

A single site was selected for further evaluation in the RI/FS from each of these three groups based on its evaluation against the modifying and final criteria, as described in Chap. 7. The following three sites were recommended for further evaluation in the RI/FS:

- Site 1,
- Site 9, and
- Site 5.

A description of each final candidate site and a summary of the site features that influenced its selection are discussed below.

8.1 SITE 1

Site 1 is located in the southwest quadrant of the Paducah Site in the watershed of Bayou Creek. The site is bounded to the east by the main rail line to PGDP and by a tributary of Bayou Creek on the north. Topography at the site is characterized as low relief, with elevations ranging from a high point at the southwest boundary to the low point on the northeast side of the site. The site meets the minimum land requirements of 110 acres.

Drainage for Site 1 is toward tributaries to Bayou Creek. The site is located out of the floodplain of Bayou Creek (see Fig. 6.1), with the exception of a very small fringe area along the northern edge of the site. Based on the design of the final site layout, it would be expected that the waste cell itself (approximately 80 acres) could be constructed within the 110-acre site without encroaching on the floodplain.

Site 1 meets the seismic criterion of avoiding areas that are within 200 ft of a fault that has displacement in Holocene time (within the last 10,000 to 12,000 years). There are no known Holocene age faults within 200 ft of the site. This would be confirmed during the Phase I, Stage 2 field characterization. There is, however, a postulated lineament of older age that crosses the western edge of the site. Field characterization would be conducted during the Stage 2 site selection to investigate this postulated lineament.

The most significant feature of Site 1 is that it is located in an area that overlies the Porters Creek Clay formation (Sect. 3.5.2). The Porters Creek Clay is approximately 100-ft thick in areas immediately southwest of PGDP and represents a significant geologic feature affecting the siting of a waste disposal facility. The clay formation controls both local groundwater and surface water flow. The clay overlies the McNairy Aquifer, providing a confining layer that separates the deeper aquifer from shallower perched

groundwater. The perched groundwater above the clay formation generally discharges laterally to surface streams such as Bayou Creek. The low permeability clay would tend to retard downward movement of contaminants in the event of a release from a facility constructed on the site. Site-specific geotechnical borings would be required to confirm the depth and extent of the clay formation prior to construction of a facility at this location.

In the RI/FS, preliminary WAC are being developed for Site 1 so that stringent water quality standards would be met in surface water (e.g., risk-based and close-based levels and ecological benchmarks are not exceeded at compliance points). Fate and transport modeling of a hypothetical future relase and migration to surface water is being conducted as part of the WAC development.

Currently, no industrial facilities or SWMUs are located within the boundaries of Site 1 that would delay startup of a waste disposal facility. The site is located upgradient of existing groundwater contamination areas, which would facilitate monitoring for releases from the proposed waste disposal facility. There are, however, aboveground transmission lines that cross the site. Depending on the final site layout, the transmission lines might or might not impact development of the site.

The site is easily accessible by rail or road for transport of construction materials or waste. An existing rail line parallels the eastern edge of the site.

Site 1 is located between the old KOW site and the existing PGDP industrial area, well away from residential areas. There are no residential wells within 4000 ft of the site. There are no known cultural resource sites within the boundaries of Site 1. As indicated in the approved SMP (DOE 2000b), the land-use designation for Site 1 is recreational use-DOE property.

Although some wetland areas are identified in Site 1, the wetlands tend to be small, discontinuous areas associated with small tributaries to Bayou Creek. Wetland mitigation requirements for Site 1 would be small compared to the other sites. Some potential Indiana bat habitat may be present in the southern portion of Site 1 but would not prevent development of a waste disposal facility.

8.2 SITE 5

Site 5 is located in the northeastern quadrant of the Paducah Site in the watershed of Little Bayou Creek. The site is bounded to the west by the secured area of PGDP and to the east by Little Bayou Creek. The approved SMP (DOE 2000b), indicates that the land-use designation for Site 5 is recreational use-DOE property.

The site meets the minimum land area requirements of 110 acres. Topography at the site is amenable to development, with only minor relief across the site (20 ft). There are no areas of unstable terrain in the vicinity of Site 5.

Drainage for Site 5 is to the east toward Little Bayou Creek, with the area located entirely out of the floodplain (see Fig. 6.1). Although there are some wetland areas on the site, they tend to be small and discontinuous (see Fig. 7.3). Mitigation measures for wetlands at Site 5 are considered minimal.

Site 5 meets the seismic criterion of avoiding areas that are within 200 ft of a fault that has displacement in Holocene time (within the last 10,000 to 12,000 years). There are no known Holocene-age faults within 200 ft of the site, and the site is located on stable terrain. This would be confirmed during the Phase I, Stage 2 field investigation. There are also no postulated lineaments traversing the site.

With the exception of overhead transmission lines that cross the site, there are currently no industrial facilities located on Site 5 that would require removal. Depending on the final configuration of a cell design on the site, the transmissions lines might or might not have an impact on the facility.

Relative to other sites located outside the secured area and above the RGA (Sites 5, 6, 7, 8, and 10), Site 5 is considered to be one of the better locations from a contaminant transport standpoint. Contaminant transport from each of the five sites was modeled using particle tracking. The particle tracking evaluated movement of a contaminant particle from a theoretical waste facility to the RGA and to an off-site receptor. Based on this preliminary analysis, Site 5 was the second slowest of the five sites. Depth to groundwater at Site 5 is estimated to be approximately 35 ft, with the depth to the RGA estimated to be approximately 50 ft. This depth to groundwater is considered an advantage because it would allow for significant waste isolation and attenuation of contaminant transport to the RGA.

In the RI/FS, preliminary WAC are being developed for Site 5 so that stringent water quality standards would be met in groundwaters (e.g., MCLs and risk-based and dose-based levels are not exceeded at compliance points). This would allow DOE to maintain its expressed goal of returning the RGA to useable status. Fate and transport modeling of a hypothetical future release is being conducted as part of the WAC development. Details of this modeling approach have been discussed with the regulators.

A waste disposal facility that is located on top of the RGA in areas where groundwater is already impacted may be preferable to a similar facility located on top of a pristine groundwater system. In the unlikely event of a potential release, there would be less impact to groundwater in areas where groundwater is already impacted. In any event, MCLs would not be exceeded at Site 5.

8.3 SITE 9

Site 9 is located in the northwest corner of the secured (fenced) portion of the PGDP site. Site 9 was selected for further evaluation in the RI/FS because it represents a "brownfield" site within the secured portion of the plant site and meets the minimum area requirements of 110 acres. As indicated in the approved SMP (DOE 2000b), the land use designation for Site 9 is industrial use.

Site 9 also meets the seismic criterion of avoiding areas that are within 200 ft of a fault that has displacement in Holocene time (within the last 10,000 to 12,000 years). There are no known Holocene-age faults within 200 ft of the site; there is, however, a postulated lineament that traverses the extreme northwest corner of the site. This would be confirmed in the Phase I, Stage 2 field investigation. Site 9 is located on land previously developed for industrial purposes and is considered stable.

A brownfield site was retained for further evaluation because the site has already been impacted by contaminants. Development of a brownfield site would minimize impacts to other, more pristine, sites. The advantages of Site 9 relative to other sites include the following:

- The area is already designated for industrial land use;
- Encroachment on wetlands, terrestrial habitat, or T&E species would be negligible;
- No further expansion of the secured area would be required;

- No further expansion of the overall waste management footprint on DOE-owned property would be required; and

- Existing infrastructure could be utilized to support the facility (roads, water, electrical, etc.).

Because Site 9 has been previously developed for industrial purposes, it has been filled and graded. As a result, the site is located above the floodplain, except for a drainage ditch running through the site. Site 9 is the only site that does not contain wetlands.

The velocity of contaminant transport from Site 9 is the lowest of the five sites that are located above the RGA. A more in-depth evaluation of fate and transport modeling from the site will be conducted in the RI/FS.

Relative to the other sites, Site 9 is the least impacted from overhead power transmission lines. The raw water line servicing PGDP does traverse the site, however. Depending on the final configuration of a cell design on the site, the water line may or may not have an impact on the facility.

The primary decisions that could affect the final selection of Site 9 in the ROD would be programmatic issues related to removal and remediation of existing facilities prior to construction. Site 9 currently contains 19 SWMUs (Table 8.1). Before Site 9 could be considered as the preferred site for a potential on-site CERCLA waste disposal facility, a number of programmatic decisions and agreements would have to be reached. These would include: schedule integration, stakeholder approval, and availability of funding.

8.4 RECOMMENDATION FOR FINAL SITE SELECTION

Sites 1, 5, and 9 should be further evaluated in the *RI/FS on Disposal Options for CERCLA-Derived Waste at the PGDP* (DOE,2002 to be published). Field characterization (seismic, geotechnical, and hydrogeological characterization) will be implemented at one or more of the three final candidate sites as part of the RI/FS. A key aspect of these field characterization studies will be to address the potential for liquefaction or Holocene faulting and to establish appropriate peak ground acceleration. Results of the field characterization will be documented in the RI/FS report. Final site selection would be described in the Proposed Plan and ROD. If it appears likely that an on-site CERCLA waste disposal facility would be part of the selected remedy, additional site characterization activities would be conducted to support design of the waste disposal facility. These site characterization activities could be initiated prior to final ROD signatures in agreement with the regulators.

Table 8.1. SWMUs and facilities located in Site 9

SWMU #	Description	Scheduled Remedial Action Dates (FY per LCB)
2	C-749 Uranium Burial Ground	2004 – 2010
3	C-404 LLW Burial Ground	2004 – 2010
5	C-746-F Classified Burial Yard	2007 – 2009
6	C-747-B Burial Ground	2008 – 2010
7	C-747-A Burial Ground	2007 – 2009
12	C-747-A UF_4 Drum Yard	2007 – 2009
13	C-746-P Clean Scrapyard	2009 – 2010
14	C-746-E Contaminated Scrapyard	2007 – 2009
15	C-746-C Scrapyard	2007 – 2009
26	C-400 to C-404 Underground Transfer Line	2008 – 2010
29	C-746-B TRU Storage Areas	2012 – 2023
30	C-747-A Burn Area	2007 – 2009
42	C-616 Chromate Reduction Facility	2008 – 2010
91	UF_6 Cylinder Drop Test Area	2001 – 2002
137	C-746A Inactive PCB Transformer/Sump	2008 – 2010
172	C-726 Sandblasting Facility	2008 – 2010
196a	C-746-A Septic Tank	2008 – 2010
196b	C-746-A Septic Tank	2008 – 2010
200	Soil Contamination South of TSCA Waste Storage Facility	2008 – 2010

Facility #	Description	D&D Dates (FY per LCB)
745b	Cylinder Yard (USEC)	2012 – 2023
745c	Cylinder Yard	2012 – 2023
746a	Waste Handling	2012 – 2023
746b	Waste Handling	2012 – 2023
616	Water Treatment (USEC)	2012 – 2023
726	Sand Blast Building (USEC)	2012 – 2023
752a	Waste Storage	2012 – 2023
753a	Waste Storage	2012 – 2023
Ditch 001	Major Surface Drainage (USEC)	
Rail Spur	Abandoned Rail Spur (USEC)	
Raw Water Line	30"–40" line from the Ohio River (USEC)	

D&D decontamination and decommissioning
FY = fiscal year
LCB = Life Cycle Baseline
LLW = low-level waste
PCB = polychlorinated biphenyl
SWMU = solid waste management unit
TRU = transuranic
TSCA = Toxic Substances Control Act of 1976
USEC = United States Enrichment Corporation

9. REFERENCES

Bailey 1994. *Ecoregions of the United States*. U. S. Department of Agriculture, U.S. Forest Service, accessed online (www.fs.fed.us/land/pubs/ecoregions) November 2000.

Barkley Regional Airport 2000. Barkley Regional Airport Information accessed November 21, 2000, at http://barkleyregional.com/info.html.

BJC (Bechtel Jacobs Company LLC) 2000a. *Paducah Site Annual Environmental Report For 1998,* BJC/PAD-98, Kevil, KY, February.

BJC 2000b. *DUF6 Conversion Facility Site Characterization Report, Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* BJC/PAD-207, prepared by Tetra Tech, Inc., Oak Ridge, TN, September.

Bureau of the Census 1990a, "Census Historical Poverty Tables," Table CPH-L-162, available at http://www.census.gov/hhes/poverty/census/cphl162.html. Accessed August 1, 2000.

Bureau of the Census 1990b. Summary Tape File C90STF3A, available at http://venus.census.gov.cdrom/lookup. Accessed August 1, 2000.

CDM Federal (CDM Federal Programs Corporation) 1994. *Investigations of Sensitive Ecological Resources Inside the Paducah Gaseous Diffusion Plant*, 7916-003-FR-BBRY, August 19.

CH2M HILL 1991a. *Results of the Public Health and Ecological Assessment, Phase II, at the Paducah Gaseous Diffusion Plant* (Draft), KY/SUB/13B-97777C P-03/1991/1, CH2M HILL Southeast, Inc., Oak Ridge, TN, April.

CH2M HILL 1991b. *Results of the Site Investigation, Phase I, at the Paducah Gaseous Diffusion Plant*, KY/ER-4, CH2M HILL Southeast, Inc., Oak Ridge, TN, March.

CH2M HILL 1992. *Results of the Site Investigation, Phase II, Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, KY/SUB/13B-97777C P-03/1991/1, CH2M HILL Southeast, Inc., Oak Ridge, TN, April.

COE (U.S. Army Corps of Engineers) 1994. *Environmental Investigations at the Paducah Gaseous Diffusion Plant and Surrounding Area, McCracken County, Kentucky, Volume V: Floodplain Investigation, Part A: Results of Field Survey*, Nashville, TN, May.

DOC (U.S. Department of Commerce) 1994. *County and City Data Book 1994*, 12th Edition, Economics and Statistics Administration, Bureau of the Census, August.

DOC 1995. *Survey of Current Business*, Volume 75, Number 4, Economics and Statistics Administration, Bureau of the Census.

DOE (U.S. Department of Energy) 1996a. *Identification and Screening of Candidate Sites for the Environmental Management Waste Management Facility, Oak Ridge, Tennessee*, DOE/OR-02-1508&D1, September.

DOE 1996b. *Resource Conservation and Recovery Act Facility Investigation/Remedial Investigation Report for Kentucky Ordnance Works Solid Waste Management Units 94, 95, and 157 at Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1405/V1&D2, KY/EM-102/V1&D2.

DOE 1996c. *Feasibility Study for Waste Area Groups 1 and 7 and Kentucky Ordnance Works Solid Waste Management Units 94, 95, and 157 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/06-1416&D2, May.

DOE 1997a. *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/07-1586&D0, March.

DOE 1997b. *Ground-Water Conceptual Model for the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/06-1628&D0, August.

DOE 1997c. *Final Waste Management Programmatic Environmental Impact Statement For Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*, DOE/EIS-0200-F, Office of Environmental Management, May.

DOE 1998. *Feasibility Study for Final Action at Solid Waste Management Unit 2 of Waste Area Group 22 at the Paducah Gaseous Diffusion Plant*, DOE/OR/06-1636&D2, September.

DOE 2000a. *Initial Assessment of Consideration of On-Site Disposal of Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Waste as a Potential Disposal Option at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky.* DOE/OR/07-1893&D1, July.

DOE 2000b. *Site Management Plan, Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/OR/07-1849&D1, November.

DOE 2000c. *Seismic Issues for Consideration in Site Selection and Design of a Potential On-Site Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Waste Disposal Facility at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1916&D1, November.

DOE 2001. *RI/FS on Disposal Options for CERCLA-Derived Waste at the PGDP, Paducah, Kentucky,* DOE/OR/07-1935&D(-1), to be published.

Drahovzal and Hendricks 1996. *Geologic Features Relevant to Ground-Water Flow in the Vicinity of the Paducah Gaseous Diffusion Plant*, Open File Report OF-97-02, Kentucky Geological Survey, November 27 (update on April 30, 1997).

Encarta 2000. "Paducah," Microsoft® Encarta® Online Encyclopedia 2000, http://encarta.msn.com ©1997-2000 Microsoft Corporation. All rights reserved.

EPA (U. S. Environmental Protection Agency) 1987. *Combined NRC-EPA Siting Guidelines for Disposal of Commercial Mixed Low-Level Radioactive and Hazardous Wastes*, March.

EPA 1997. *Sensitive Environments and the Siting of Hazardous Waste Management Facilities*, EPA/530-K-97-003, May.

EPA 2000. *Social Aspects of Siting RCRA Hazardous Waste Facilities*, EPA 530-K-00-005, April.

Evaldi and McClain 1989. Evaldi, R.D., and D.L. McClain, *Streamflow, Specific-Conductance, and Temperature Data for Bayou and Little Bayou Creeks near Paducah, Kentucky, August 15 and 16, 1989*, U. S. Geological Survey, Louisville, KY.

Fryar and Wallin 1998. Fryar, Alan E, and Eric J. Wallin, *Spatial and Temporal Variability in Seepage Between a Contaminated Aquifer and Tributaries to the Ohio River*, Water Resources Research Institute, University of Kentucky, Lexington, KY, September.

Harrison and Schultz 1994. "Strike-Slip Faulting at Thebes Gap, Missouri and Illinois: Implications for New Madrid Tectonism," Tectonics, Vol. 13, pp. 246-257.

Hildenbrand and Hendricks 1995. "Geophysical Setting of the Reelfoot Rift and Relations Between Rift Structures and the New Madrid Seismic Zone," in K.M. Shedlock and A.C. Johnston, eds., "Investigations of the New Madrid Seismic Zone," U.S. Geological Survey Professional Paper 1538-E, 30 p.

Hoffman et al. 1996a. "Reflection Seismic Evidence of Quaternary Faulting at Dudley Ridge, Southeastern Missouri," Seismological Society of America, 1996 Annual Meeting, St. Louis, MO, April.

Hoffman et al. 1996b. "Faulting at English Hill in Southeastern Missouri," Seismological Society of America, 1996 Annual Meeting, St. Louis, MO, April.

Humphrey, M. 1976. *Soil Survey of Ballard and McCracken Counties, Kentucky*, Soil Conservation Service, U.S. Department of Agriculture, February.

ICBO (International Conference of Building Officials) 1988. Uniform Building Code, Whittier, CA.

Jacobs (Jacobs Engineering Group Inc.) 1995. *Functions and Values Analysis for the Drainage Area South of Solid Waste Management Units 2 and 3 of Waste Area Group 22 at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, August.

KCWD (Kentucky Cabinet for Workforce Development) 1998. "Unemployment Rates Fall in 108 Counties," news release, accessed August 3, 1999, at http://www.state.ky.us/agencies/wforce, news release dated May 29.

KCWD 1999. "Kentucky Labor Force Estimates, Preliminary June 1999," accessed August 5, 1999, at http://www.des.state.ky.us/agencies/wforce/des/lmi/lfd/clf/junadd99p, Frankfort, KY, July.

KDFWR (Kentucky Department of Fish and Wildlife Resources) 2000. "Mist Net Surveys for the Indiana Bat (*Myotis sodalis*) at West Kentucky Wildlife Management Area," February.

Keifer et al. 1996. "Review of Illinois State Geological Survey study on Quaternary faulting in southern Illinois and reconnaissance of neotectonic structures of southern Illinois and western Kentucky," Kentucky Geological Survey, ser. 11, Open-File Report OF-97-01`.

KEQC (Kentucky Environmental Quality Commission) 1992. *State of Kentucky's Environment: A Report of Progress and Problems*, Frankfort, KY.

Klein and Hsui 1987. "Origin of cratonic basins," Geology, v. 15, pp. 1094-1098.

Kolata and Nelson 1991a. "Tectonic history of the Illinois Basin," in Leighton et al. eds., "Interior Cratonic Basins," American Association of Petroleum Geologists memoir 51, pp. 263-285.

Kolata and Nelson 1991b. "Basin-forming mechanisms of the Illinois Basin," in Leighton et al. eds., "Interior Cratonic Basins," American Association of Petroleum Geologists Memoir 51, pp. 287-292.

KYTC (Kentucky Transportation Cabinet) 2000. *Traffic Counts Summary* available online at www.kytc.state.ky.us. Accessed November 27, 2000.

Leighton et al. 1991. "Interior Cratonic Basins," American Association of Petroleum Geologists Memoir 51, 819 p.

LMES (Lockheed Martin Energy Systems, Inc.) 1992a. *Report of the Paducah Gaseous Diffusion Plant Groundwater Investigation Phase III,* KY/E-150, Hydrogeological Services Section, Environmental Restoration Division, Paducah Gaseous Diffusion Plant, Paducah, KY, November.

LMES 1992b. *Paducah Gaseous Diffusion Plant Groundwater Protection Program Plan,* KY/ER-2, Rev. 1, Hydrogeological Services Section, Environmental Restoration Division, Paducah Gaseous Diffusion Plant, Paducah, KY, January.

McCutchan, H. 1998. *Bat Survey Conducted at Vortec Research, Development, and Demonstration (RD&D) Project Site and Surrounding Area Adjacent to the Paducah Gaseous Diffusion Plant, McCracken County, Kentucky*, prepared for Systematic Management Services, Inc., Paducah, KY, August 25.

MMES (Martin Marietta Energy Systems, Inc.) 1993. *Paducah Gaseous Diffusion Plant Environmental Report for 1992*, KY/E-164, Paducah, KY, September.

NCDC (National Climatic Data Center) 2000. "1999 Local Climatological Data Annual Summary with Comparative Data, Paducah, Kentucky."

Nelson 1995. "Structural features in Illinois," Illinois State Geological Survey Bulletin 100, 144 p.

Nelson 1998. "Bedrock Geology of the Paducah $1^{\circ}x2^{\circ}$ CUSMAP Quadrangle, Illinois, Indiana, Kentucky, and Missouri," U.S. Geological Survey Bulletin 2150-B.

Nelson et al. 1996. "Quaternary faulting in the New Madrid Seismic Zone in southernmost Illinois," Final technical report to the U.S. Geological Survey under the National Earthquake Hazards Reduction Program, award no. 1434-95-G-2525, 41 p., January.

Paducah Sun 2000. "McCracken files lawsuit against Patton's smog list," June 21, by Anne Thrower.

Palmer et al. 1996. "Neotectonic History of the Benton Hills, Southeast Missouri," Geological Society of America, Southeastern Section Meeting.

Street, R., and Langston, C. 1998. *Acquisition of SH-Wave Seismic Reflection and Refraction Data in the Area of the Northeastward Trending Contaminant Plume at the PGDP*, final report, Department of Geological Sciences, University of Kentucky, July 31.

Sykora, D.W., and Davis, J.J. 1993. *Site-Specific Earthquake Response Analysis for Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, GS-93-14, August.

USDA (U.S. Department of Agriculture) 1976. *Soil Survey of Ballard and McCracken Counties, Kentucky*, Soil Conservation Service, Paducah, KY, February.

USGS (U.S. Geological Survey) 1973. Davis, R.W., Lambert, T.W., and Hanson, A.J., *Subsurface Geology and Ground Water Resources of the Jackson Purchase Region, Kentucky,* Geological Survey Water-Supply Paper 1987.

APPENDIX A

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR SITE SUITABILITY

Table A.1. Disposal site suitability requirements

Action	Requirements	Prerequisite	Citation
	Disposal Site Suitability Requirements		
Siting of a RCRA landfill	Portions of new facilities where treatment, storage, or disposal of hazardous waste will be conducted shall not be located within sixty-one (61) m (approximately 200 ft) of a fault which had displacement in Holocene time.	Construction of a RCRA hazardous waste landfill **applicable**	40 *CFR* 264.18 401 KAR 34:020 Section 9 (1)
	In order to determine the applicability of the seismic standard, Section 9 (1) of 401 KAR 34:020, the owner or operator of a new facility shall identify the political jurisdiction (county, township, or election district) in which the facility is proposed to be located.	Construction of a RCRA hazardous waste landfill in Kentucky **applicable**	401 KAR 38:090
	Must demonstrate compliance with the seismic standard. This demonstration may be made using either published geologic data or data obtained from field investigations carried out by the applicant. The information provided shall be of such quality to be acceptable to geologists experienced in identifying and evaluating seismic activity. The information submitted shall show either of the following:	Construction of a RCRA hazardous waste landfill in McCracken County, Kentucky **applicable**	401 KAR 38:090

Table A.1. Disposal site suitability requirements (continued)

Action	Requirements	Prerequisite	Citation
	• No faults which have had displacement in Holocene time are present, or no lineations which suggest the presence of a fault (which have had displacement in Holocene time) within 3000 ft of a facility are present, based on data from the following: – Published geologic studies; – Aerial reconnaissance of the area within a five (5) mile radius from the facility; – An analysis of aerial photographs covering a 3000 ft radius of the facility; and – If needed to clarify the data, a reconnaissance based on walking portions of the area within 3000 ft of the facility; or		

Table A.1. Disposal site suitability requirements (continued)

Action	Requirements	Prerequisite	Citation
	• If faults (to include lineations) which have had displacement in Holocene time are present within 3000 ft of a facility, no faults pass within 200 ft of the portions of the facility where treatment, storage, or disposal of hazardous waste will be conducted, based on data from a comprehensive geologic analysis of the site. Unless a site analysis is otherwise conclusive concerning the absence of faults within 200 ft of such portions of the facility, data shall be obtained from a subsurface exploration (trenching) of the area within a distance no less than 200 ft from portions of the facility where treatment, storage or disposal of hazardous waste will be conducted. Such trenching shall be performed in a direction that is perpendicular to known faults (which have had displacement in Holocene time) passing within 3000 ft of the portions of the facility where treatment, storage, or disposal of hazardous waste shall be conducted. Such investigation shall document with supporting maps and other analyses the location of any faults found.		
	A facility located in a 100-year floodplain [as defined in 40 *CFR* 264.18(b)(2)] must be designed, constructed, operated and maintained to prevent washout of any hazardous waste, unless can be demonstrated that procedures are in effect which will cause the waste to be removed safely, before flood waters can reach the facility.	Construction of a RCRA hazardous waste landfill **applicable**	40 *CFR* 264.18(b)(1) 401 KAR 34:020 Section 9 (2)

Table A.1. Disposal site suitability requirements (continued)

Action	Requirements	Prerequisite	Citation
Siting of a TSCA landfill	The landfill must be located above the historical high groundwater table. The bottom of the landfill liner shall be at least 50 ft above the historical high water table.	Construction of a TSCA chemical waste landfill **applicable**	40 *CFR* 761.75(b)(3)
	There shall be no hydraulic connection between the site and standing or flowing surface water.		
	Floodplains, shorelands and groundwater recharge areas shall be avoided.		
	Diversion structures capable of diverting all surface water runoff from a 24-hour, 25-year storm shall be provided.	Construction of a TSCA chemical waste landfill (above the 100-year floodwater elevation) **applicable**	40 *CFR* 761.75(b)(4)(ii)
	The landfill site shall be located in an area of low to moderate relief to minimize erosion and to help prevent landslides or slumping.	Construction of a TSCA chemical waste landfill **applicable**	40 *CFR* 761.75(b)(5)
Siting of a LLW disposal facility	Disposal site shall be capable of being characterized, modeled, analyzed, and monitored.	Land disposal of LLW **relevant and appropriate**	902 KAR 100:022 Section 22 (1)
	Areas must be avoided having known natural resources which, if exploited, would result in failure of the cell to meet performance objectives.	Land disposal of LLW **relevant and appropriate**	902 KAR 100:022 Section 22 (4)
	Disposal site must be generally well drained and free of areas of flooding and frequent ponding. Waste disposal shall not take place in a 100-year floodplain, coast high-hazard area, or wetland.	Land disposal of LLW **relevant and appropriate**	902 KAR 100:022 Section 22 (5)
	Upstream drainage areas must be minimized to decrease the amount of runoff which could erode or inundate the disposal unit.	Land disposal of LLW **relevant and appropriate**	902 KAR 100:022 Section 22 (6)

Table A.1. Disposal site suitability requirements (continued)

Action	Requirements	Prerequisite	Citation
	The disposal site must provide sufficient depth to the water table that ground water intrusion, perennial or otherwise, into the waste will not occur.	Land disposal of LLW **relevant and appropriate**	902 KAR 100:022 Section 22 (7)
	If it can be conclusively shown that disposal site characteristics will result in molecular diffusion being the predominant means of radionuclide movement and the rate of movement will result in the performance objectives being met, wastes may be disposed below the water table. In no case will waste disposal be permitted in the zone of fluctuation of the water table.		
	The hydrogeologic unit used for disposal shall not discharge ground water to the surface within the disposal site.	Land disposal of LLW **relevant and appropriate**	902 KAR 100:022 Section 22 (8)
	Areas must be avoided where tectonic processes such as faulting, folding, seismic activity may occur with such frequency to affect the ability of the site to meet the performance objectives.	Land disposal of LLW **relevant and appropriate**	902 KAR 100:022 Section 22 (9)
	Areas must be avoided where surface geologic processes such as mass wasting, erosion, slumping, landsliding or weathering may occur with such frequency and extent to affect the ability of the disposal site to meet performance objectives or preclude defensible modeling and prediction of long-term impacts.	Land disposal of LLW **relevant and appropriate**	902 KAR 100:022 Section 22 (10)
	The disposal site must not be located where nearby activities or facilities could impact the site's ability to meet performance objectives or mask environmental monitoring.	Land disposal of LLW **relevant and appropriate**	902 KAR 100:022 Section 22 (11)

RECORD COPY DISTRIBUTION

File—EMEF DMC—RC